

**JANUARY  
1962**

PRICE 75 CENTS

# **ELECTRICAL CONSTRUCTION AND MAINTENANCE**

WITH ELECTRICAL CONTRACTING

## **ELECTRICAL WORK IN 1962**

Outlook for 1962 shows vigorous growth in electrical activity can be expected in a record year for physical volume of construction.

Page 53

## **POOL LIGHTING CIRCUITS**

How to solve 12-volt swimming pool lighting problems. Selecting circuits and wire sizes for optimum low-voltage lighting effects.

Page 56

## **POWERING MISSILE RESEARCH**

Electrical power and control applications used in the operation of a modern rocket engine research and development facility.

Page 62

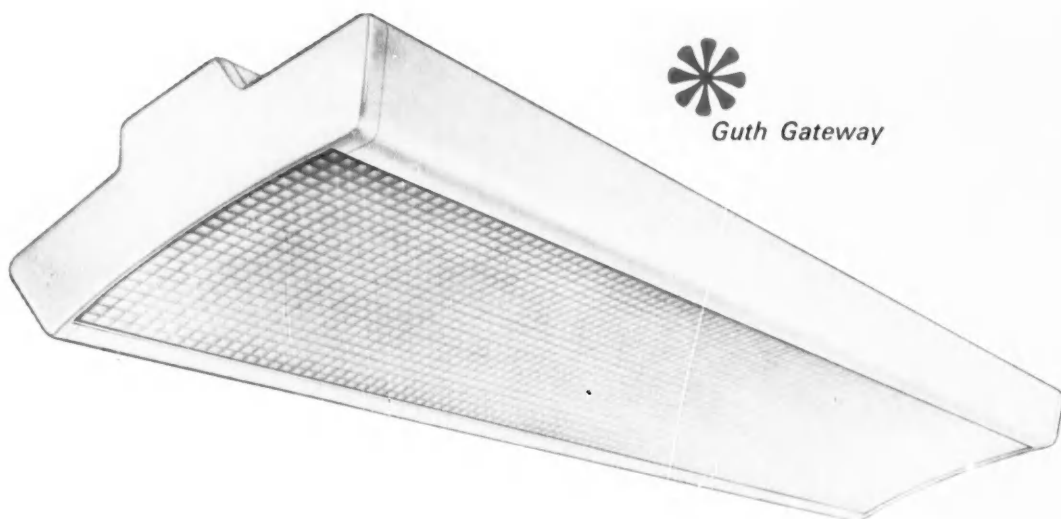
*Also in this issue*

**NUCLEAR ATTACK and INDUSTRIAL SURVIVAL**

A McGraw-Hill Special Report

A MCGRAW-HILL PUBLICATION

61ST YEAR



Guth Gateway

## Sure it looks good, but why specify it?

Gateway's intrinsic beauty is obvious. But that's only half the story. Here is the other half — engineering and construction features that make Gateway worthy of your specification. Gateway is *not* a wrap-a-round. The concave bottom actually hinges separately from the rugged 20-gauge steel ends. Simplifies relamping considerably — one strong panel, not an unwieldy basket, to hinge down.

The steel ends won't warp; also they add extra rigidity to the fixture in continuous-row mountings, or as individual units. (No glue or piano wire holding it together.) The 4' or 8', one-piece *tubular* plastic side wings with capped ends (minimize dust and dirt from holding conventions therein) offer greater strength and lower side-brightnesses.

The *concave* Gratelite® bottoms (choice of Prismoid\*\* or Standard Gratelite) are solidly molded with built-in ultra-violet resistant additives. Both Gratelites feature  $\frac{3}{8}$ " open cubicles — dust and dirt filter thru — doesn't mar beauty.

All the steel parts, including the channel, are formed from electrolytic, *zinc-coated* and phosphatized steel.

There's hardly any chance of their rusting regardless of humidity or climate. Each steel part is finished in the new super hard, super efficient *Acrylic* enamel. This is the finish automakers use, and say "never needs polishing". Paint people tell us "it most closely approaches the physical properties of porcelain enamel"

Of course, each unit includes a CBM/ETL Ballast, plus — we heat test Gateways to insure that ballast-case operating temperatures will not exceed 90°C in a 75°F room ambient temperature. (Add these last 13 words to every specification and watch competitors back away!)

Gateway is available in *2, 3 or 4 lamps* — in the same "full-width" fixture — not a corridor looking unit in a carload.

For the final test, write us on your letterhead. We'll have our salesman show you a "live" demonstration of Gateway. If you just don't like salesmen, write us and we'll send our Gateway Brochure. In either case, you'll like Gateway, a fixture that proves itself.



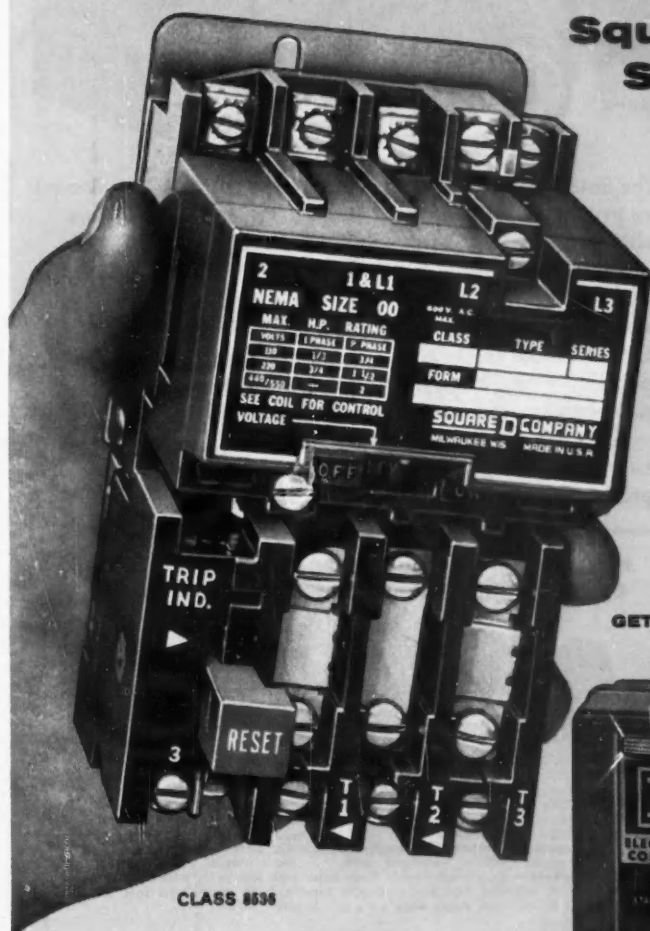
**THE EDWIN F. GUTH CO., 2615 WASHINGTON BLVD., BOX 7079, ST. LOUIS 77, MO.**

\* © U.S. PAT. NO. 2,745,001 — CAN. PAT. 1957, NO. 538,245 — \*\* © U.S. PAT. NO. 2,904,673



# NEW SMALL MAGNETIC STARTER COSTS LESS, SAVES SPACE ON LOW-HORSEPOWER JOBS!

**Square D NEMA Size 00  
Starter Rated  $\frac{3}{4}$  to 2 Hp  
for 3-Phase Service**



• You no longer need to buy more starter capacity than you can use for low-horsepower jobs! This new Square D Size 00 starter is compact, easy to install, simple to use and maintain—and it costs 18% less than the Size 0 starter you formerly had to specify to get the advantages of magnetic control! With no sacrifice in quality, this new starter provides: straight-through wiring—pressure-type terminals—1-piece overload relays for complete motor protection—pushbutton or selector switch optional in the cover. Also available without overload relays.

**GET THE COMPLETE STORY!** Write for Bulletin SM-297, Square D Company, 4041 North Richards St., Milwaukee 12, Wisconsin.



New starter available either open or in NEMA Type 1 enclosure. Enclosure shown with pilot light and start-stop push button in cover. Pilot light or push button available in kit form for easy field installation.

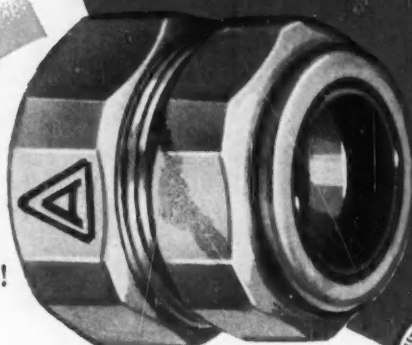


**SQUARE D COMPANY**

*wherever electricity is distributed and controlled*

Another  
APPLETON  
"FIRST"

No Welding!  
No Crowding!  
No Wire Damage!  
No Shaking Loose!

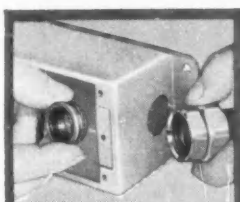


PATENT PENDING



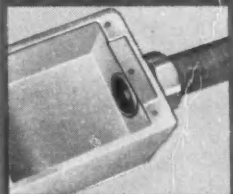
# APPLETON®

## "STN" Sealtite Connectors for Liquid-Tight, Flexible Conduit



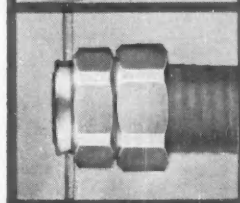
### NEW LOCKING EDGE ON BODY

Special design of connector body locking edge bites into box wall and forms a constant, uniform seal . . . no welding . . . no lock-nut . . . always a positive ground!



### MORE WIRING ROOM

No projecting threads inside box. No weld. Wedge adapter hugs box wall almost flush when tightened. Forms "cold-weld" seal. No wrench needed inside box.



### NEW WEDGE ADAPTER

Male shank of unique APPLETON wedge adapter "finger tightens" into connector body. Flared surface of adapter wedges box wall against locking edge of body. Forms full 360° contact on both sides of box wall.

### New Insulated Throat



Acetate, insulating insert recessed into wedge adapter absolutely protects against wire damage . . . without reduction in throat diameter. Perfect for extreme vibration conditions. Nothing to come loose, deteriorate, crack, or break!

The fastest, most economical and trouble-free method yet devised for making liquid-tight, flexible conduit connections is yours with the new APPLETON "STN" Sealtite Connectors. The exclusive wedge adapter used with all APPLETON liquid-tight fittings provides a lasting "cold-weld" seal. The "STN" provides a positive ground while the adapter pulls up almost flush inside the box to eliminate ragged edges and leave maximum wiring room. The acetate insulated throat protects wires without reduction of throat diameter! Only one wrench needed to install! Constant pressure of metal-to-metal seal resists vibration indefinitely! Full information and specifications available on request.

### Patented Brass Ferrule Assures a Positive Ground . . . Crimping Excludes Liquids & Fumes from Connection



### HERE'S HOW IT WORKS

Brass ferrule screws into spiralled inner wall of liquid-tight tubing forming continuous positive metal-to-metal ground. Compression nut and connector body crimps ferrule into outer neoprene wall to form permanent seal against liquids, fumes, and other foreign matter. Threaded shank of wedge adapter, when held in knockout hole, "finger tightens" into connector body. Locking edge on connector body bites into box wall when tightened (1/4 turn of wrench) and pulls adapter almost flush with inner box wall. A perfect installation every time . . . quick, easy, safe!

Sold Through Franchised Distributors Only

**APPLETON ELECTRIC COMPANY**  
1701 Wellington Chicago 13, Illinois

Also  
Manufacturers  
of:



Explosion-Proof  
Fixtures



"EX" Series  
Flexible Couplings



Explosion-Proof  
Junction Units



Explosion-Proof  
Hand Lamp



# ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The  
Electrifier and Electrical Record. Established 1901

Published for electrical contractors, electrical departments  
in industry, engineers consultants, inspectors and motor  
shops. Covering engineering, installation, repair, mainte-  
nance and management in the field of electrical construc-  
tion and maintenance.

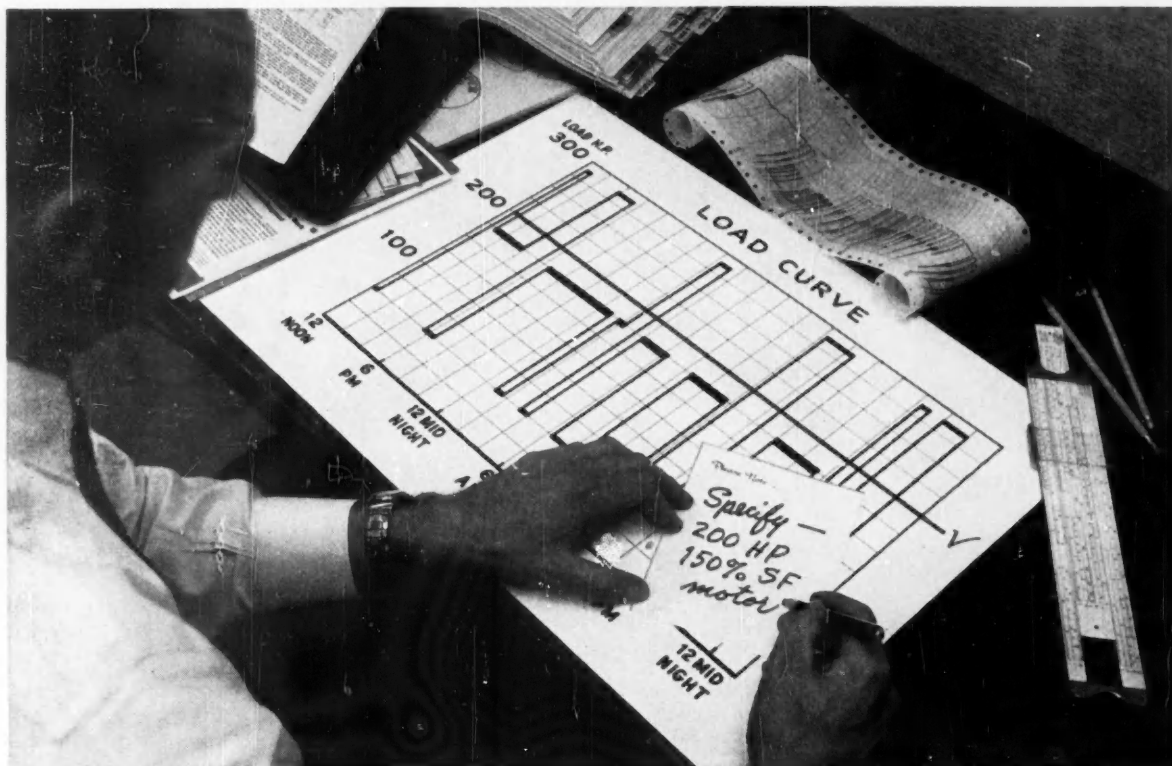
61ST YEAR • JANUARY 1962

<b>Sidelights</b> .....	7
<b>Washington Report</b> .....	9
<b>Business in '62, An Editorial</b> .....	51
<b>Outlook for 1962</b> .....	53
Prospects are excellent for a record construction year with gains of 7% or more expected in electrical construction and modernization activity.	
<b>Solving the Circuit Problems of 12-Volt Pool Lighting</b> .....	56
By J. H. WATT—The causes and effects of improper voltage supply to 12-volt lamps used with wet-niche swimming pool fixtures. Recom- mended circuit sizes and advancements in lamp and transformer de- signs are also discussed.	
<b>Planning Cuts Man-Hour Unit Costs</b> .....	59
By STAN ALEXANDER—High labor costs emphasize importance of quality tools and installation equipment, method simplification and, above all, experienced job bosses who can conserve effort by advocating better than specified electrical components incorporating installation- aiding plus-values.	
<b>Power for Rocket Engine Research</b> .....	62
By BRAHAM LATCH—A close look at the extensive electrical power and control applications integrated in operations of a modern facility for development of rocket engines.	
<b>Estimating Forum—XVII</b> .....	66
By RAY ASHLEY—Volume and operating costs—Part 1.	

**MORE**

**"Nuclear Attack and Industrial Survival"**  
A special report following page 76

# Over-motoring Out-moded



## Specify horsepower for nominal loads, Service Factor to handle the peaks!

Specifying motors with nameplate horsepower rated for peak load conditions is rapidly being out-moded as too expensive.

Today, it's far more economical . . . and just as reliable . . . to specify silicone insulated extra service factor motors with horsepower ratings based on nominal load conditions.

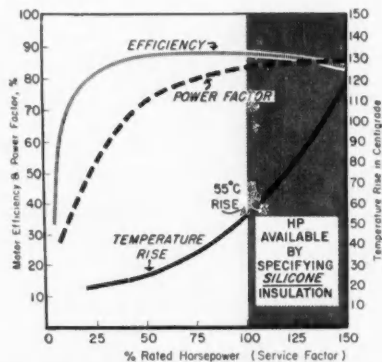
**Additional horsepower** output — up to 50% above nameplate rating — is available for peak loads.

Where does this additional capability come from? It's the hidden horsepower in the higher service factor rating! It's the result of the exceptional thermal stability of silicone insulating materials.

**Life and reliability** of these motors is unaffected by peak loads . . . silicones are immune to the heat of even constant loads within the service factor rating. So why specify a 300-hp motor when a 200-hp motor with a 150% service factor is what's needed? Silicone insulated extra service factor motors give you these extras, too:

**Top efficiency** is obtained under normal load since the motor is operating at its designed horsepower rating most of the time.

**Additional savings** in several ways: additional nameplate horsepower is usually more expensive than the extra service factor silicone insulation provides; additional horsepower requires extra floor space and heavier mountings; over-motoring power factor problems are eliminated or minimized.



Free brochure—"Specify  
Silicone Insulated Equipment and Save."  
Write Dept. 3601.



**Dow Corning CORPORATION**  
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.



W. T. STUART, Editor

Alice McMullen, Managing Editor

Associate Editors

Berlon C. Cooper, New York

August Eckel, Chicago

J. F. McPartland, New York

W. J. Novak, New York

Hugh P. Scott, San Francisco

John H. Watt, New York

Art Editor

L. E. Devendorf

Assistant Editor

R. J. Lawrie

Editorial Assistant

Mary A. Corich

Consulting Editors

Ray Ashley, Chicago

R. L. Lloyd, Washington, D.C.

B. Z. Segall, New Orleans

R. E. Ward, Nashville

Douglas Greenwald, Man., Economic Services

George B. Bryant, Jr., Chief Correspondent, Washington Bureau

John Wilhelm, Manager, News Bureaus

W. W. GAREY, Publisher

A. L. De Weerd, Circulation Manager

W. C. Carmichael, Business Manager

Ann P. Barrett, Production Manager

R. A. Hubley, Advertising Sales Manager

A. B. Conklin, New York

E. P. Gardner, New York

A. E. French, Jr., Philadelphia

F. J. Seiler, Cleveland

J. E. Lange, Detroit

H. E. Green, Jr., Chicago

R. R. Ream, Chicago

John Hernan, San Francisco

F. E. Le Beau, Dallas

D. O. Hanson, Houston

Richard Bowman, Los Angeles

R. H. Powell, Atlanta

Scott Hubbard, Portland

Member of  
AUDIT BUREAU OF CIRCULATIONS and  
ASSOCIATED BUSINESS PUBLICATIONS



# ELECTRICAL CONSTRUCTION AND MAINTENANCE

JANUARY • 1962 *continued*

Planning for New Plant Start-Up .....	68
By R. J. LAWRIE—During design, construction and initial start-up of a new plant, electrical problems facing the engineer demand fast decisions.	
Electric Heating Forum No. 15 .....	72
Electric heat is best.	
Practical Methods .....	81
Asbestos cement ducts resist salt-corrosion; 8-kw M-V clusters light parking area; decentralized battery charging saves time.	
Motor Shops .....	89
Rubber glove test laboratory; inventory enhanced by paint, indexing, light; shop elevator speeds equipment handling.	
Reader Service .....	97
Product news announcements; catalogs and bulletins.	
Reader's Quiz .....	121
Questions and answers on receptacle ratings; controlling exhaust blowers.	
Questions on the Code .....	127
Answers to code questions on branch-circuit conductor size; motor transfer switch; fixed electric heaters; fuses for 277-volt circuits; heating cables; SE cables as feeder; wiring methods; branch-circuit taps; wiring for floodlight trucks.	
In the News .....	143
Dates Ahead .....	149

Vol. 61, No. 1

ELECTRICAL CONSTRUCTION and MAINTENANCE

JANUARY 1962

Published monthly with an additional issue in September by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948). Founder. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 36, N.Y. Printed in Albany, N.Y. **Officers of the Publications Division:** Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callahan, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. **Officers of the Corporation:** Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

This publication is available only by paid subscriptions which are solicited from persons engaged in electrical construction, maintenance or

consulting services. The publisher reserves the right to refuse subscription service to others. **Position and company connection must be indicated on subscription orders.**

United States subscription rate for individuals in the field of the publication \$3.00 per year. This issue 75 cents. Electrical Products Guide \$2.50. Canada \$5.00 a year. All other countries, \$20.00 a year, payable in advance. Second class postage paid at Albany, N. Y., and at additional mailing offices. Printed in U.S.A. Title registered in U.S. Patent Office. © Copyrighted 1962 by McGraw-Hill Publishing Co., Inc. — All Rights Reserved.

**UNCONDITIONAL GUARANTEE:** Subscription service may be discontinued at any time on written request by the subscriber. The publisher will refund the part of the subscription price applying to the remaining unexpired portion of the subscription.

**SUBSCRIPTION:** Send subscription correspondence and change of address to Subscription Manager, Electrical Construction and Maintenance, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Subscription Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Please allow one month for change to become effective.

Postmaster . . . Please send form 3579 to Electrical Construction and Maintenance, 330 West 42nd St., New York 36, N. Y.



**"Home buyers will go for an improvement like that. Thanks for suggesting it!"**

This is a typical comment after the Graybar man spells out a new item to help an electrical contractor.

And many are the practical suggestions the Graybar man makes in the course of his calls. For he knows "what's cooking." He's wide awake to the new developments in home lighting, for example. He's a bug on high efficiency, time-saving tools and equipment. But whether he talks entrance panels, wiring devices, tools, fixtures or other, he makes it

his business to improve *your* business.

Moreover, the Graybar Field Salesman is just one of four experts who make up the Graybar contractor service team. The others: Inside Salesman, Counterman, Specialist. And somewhere along the line all four can be of substantial help to you . . . *can help you improve your business . . . reduce your costs . . . speed your work.*

It will pay you to know Graybar better. Call us.

915

**Graybar Service includes:** Objective recommendations • On-the-job technical help • Most complete lines • Planned stocks to meet your needs • Expert counter service • Speedy handling of will-calls.

# GraybaR

ELECTRIC COMPANY, INC.

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • OFFICES IN OVER 130 PRINCIPAL CITIES





# Sidelights

## SHELTER

A special editorial report "Nuclear Attack and Industrial Survival" appears simultaneously in all McGraw-Hill publications this month. The report is the work of a group of editors, including specialists in science, engineering, technology and industrial practice, who have brought together an objective, dispassionate exploration of a subject which is among the most controversial issues of our time. But there is increasing public awareness that the problems must be faced in the light of the best information available.

In concluding their foreword, the editors say, "Let us make one thing absolutely clear. If any part of the pages that follow can be accused of sensationalism, then we have failed our job. The Editors of McGraw-Hill do not believe that nuclear war is likely. But we do believe that the possibility of it . . . however remote . . . must be examined."

## WALL CHARTS

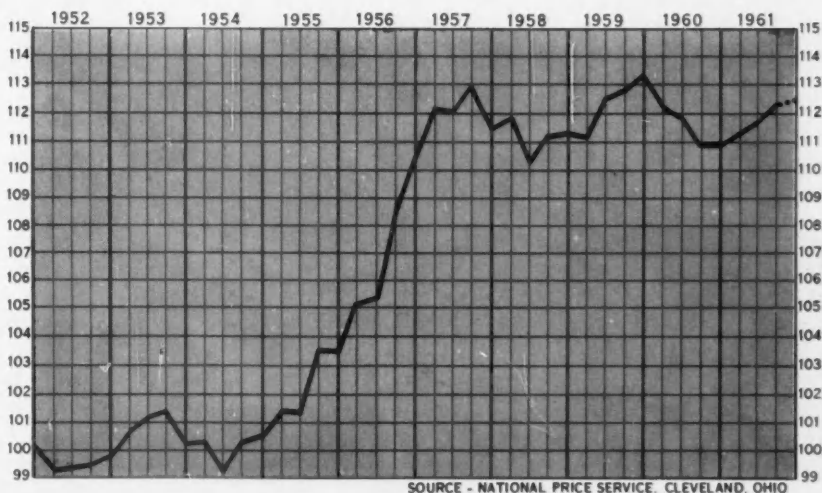
Are you thumbing through handbooks and codes for wire tables, conduit sizes and the like? Would accurate, handy, wall charts of essential data save you time and annoyance? Then hear this! The editors of *Electrical Construction and Maintenance* are compiling a series of full size, 23 in. by 35 in. wall charts of the most essential and most used tabular data from the National Electrical Code. Attractively printed in two colors on tough white Texoprint, the data are especially arranged for clear legibility and quick reference to both figures and applicable notes. The first chart, "Carrying Capacity of Conductors in Raceways," covering both copper and aluminum is now available. The price is \$1.00 each. Address your order to Wall Chart, *Electrical Construction and Maintenance*, 330 W. 42nd St., New York 36, N. Y.

## COST CURVE

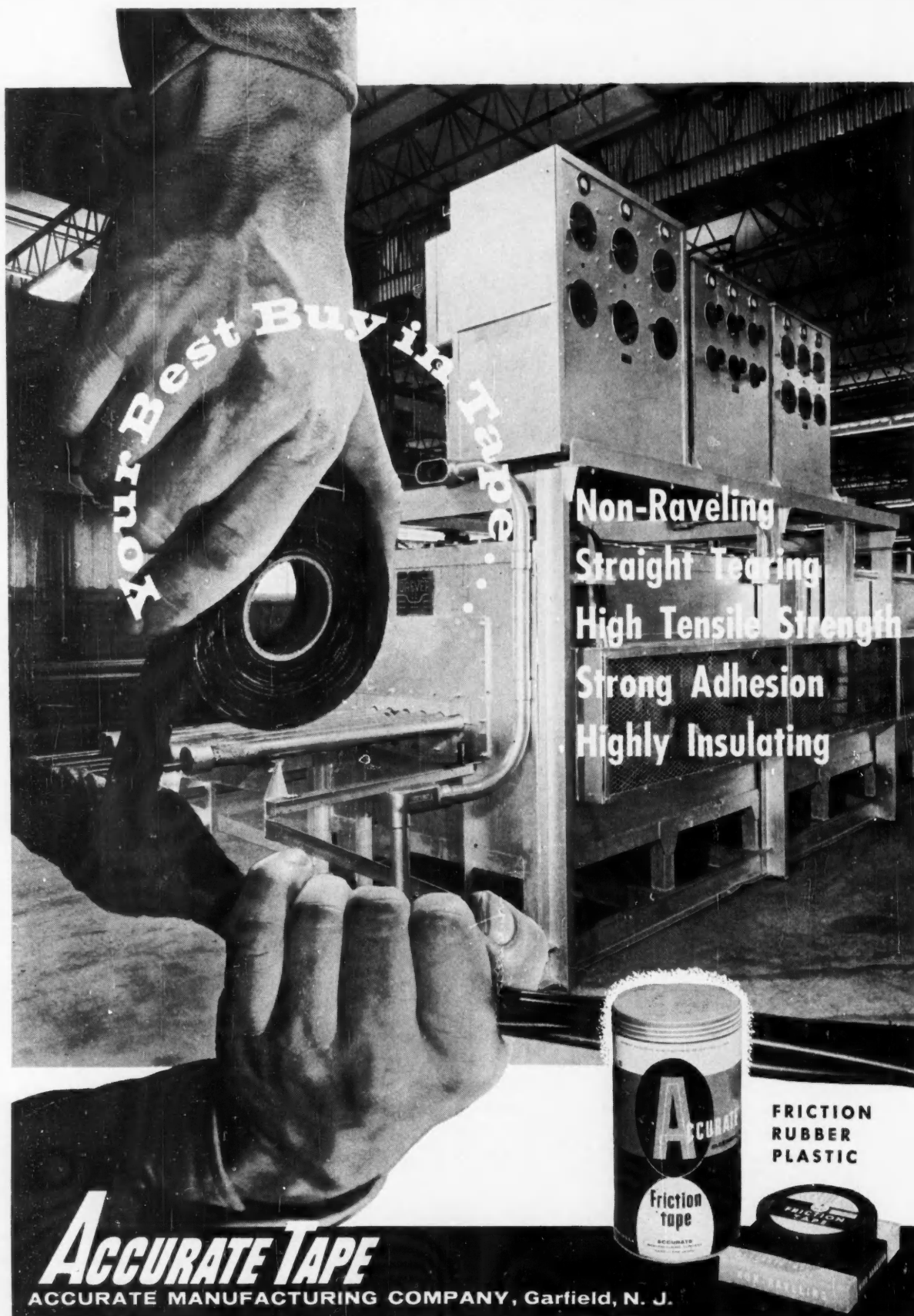
The chart below summarizes our monthly materials cost index for the past ten years. The index values are based upon a representative bill of materials, priced monthly by the National Price Service of Cleveland, Ohio, and compared with the 1951 price of the same or equivalent materials. Beginning next month a new series of three cost curves will be presented based upon representative bills of materials for industrial, commercial and residential work respectively. The new curves are expected to reflect more accurately significant cost changes in particular classes of work that might be lost in a larger composite index.

### ELECTRICAL MATERIALS COST INDEX

BASE LINE IS 100 AND REPRESENTS COSTS OF A TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. THE INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE END OF EACH QUARTER.



SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO




**Your Best Buy in Tape**

**Non-Raveling  
Straight Tearing  
High Tensile Strength  
Strong Adhesion  
Highly Insulating**

**ACCURATE TAPE**  
ACCURATE MANUFACTURING COMPANY, Garfield, N. J.

**FRICION  
RUBBER  
PLASTIC**



# Washington Report

JANUARY • 1962

**Business will be much better in 1962** than it was in 1961, based on current economy statistics. For example, most indicators are now at record highs, and in all cases higher than they were a year ago. Further, increases in any one indicator tend to interact on other indicators. Consider industrial production as a case in point. Last month the FRB Index of industrial output was at a record 115% of 1957 average, up from 102% in January of last year. Thus, an improvement of better than 1-point a month has been made through 1961, and indications are that production will continue to improve about 1-point a month for the first half of this year, to 121. That means considerable improvement in business this year compared with 1961, and other indicators reflect the same outlook.

Other highlights of outlook for 1962 (on assumption there will be no steel strike):

- **Gross National Product** will probably increase 7% (to \$570 billion).

- **Consumer spending** will increase 5% to 6%, with auto sales contributing substantially. Retail sales in 1961 totaled nearly \$225 billion.

- **Electric power output** at end of 1961 was at record highs, averaging about 8% ahead of similar periods one year earlier, up to 16.7 billion kwhr weekly.

- **Building construction** will increase about 5% to \$60 billion, up from \$57.3 billion in 1961.

- **Personal income** will continue to rise, and with decreasing consumer indebtedness will spur retail sales in both hardgoods and softgoods—appliances, autos, furniture, food, clothing, etc.

**New construction expenditures will reach \$60 billion in 1962**, up 5% from 1961's record \$57.3 billion, according to Dept. of Commerce forecast. Commercial construction showed a 12% gain in 1961, is expected to increase 4% this year to about \$4.8 billion. Private hospital and institutional building is slated to rise 11% this year, to \$875 million. Industrial construction, which declined about 3% last year, should turn up modestly this year. Highway spending may total \$6.1 billion this year, compared with \$5.7 billion in 1961.

Housing starts this year will rise about 8%, Commerce Dept. forecasts, to about 1.4 million. Starts last year were about 1.3 million. Residential spending last year was under \$16.3 billion, is expected to total \$17.4 billion in 1962.

Total construction spending in November of last year was \$5.1 billion, down about 5% from the October total, but the decline was less than the usual seasonal drop-off.

**Public fallout shelters will be aided by the Defense Department** under new plans for a cost-sharing civil defense program to help states and local communities build shelters in schools, hospitals and other public buildings. Civil defense budget request will be around \$700 million for next fiscal year, beginning July 1, which compares with \$209 million budget this current fiscal year. Federal assistance would thus be applied primarily to community-type shelters, with aid for family shelters limited to plans and technical assistance.

Introducing

# PLASTI-BOND\*

*the only complete conduit system  
permanently protected by  
fused-on PVC coating*



*...lowest installed cost  
for CORROSIVE AREAS*

Plasti-Bond is Pittsburgh Standard hot dip galvanized steel conduit, elbows, and couplings, heavily coated with polyvinyl chloride *permanently fused-on at the factory*. Overlapping sleeve design creates tight, pressure sealed joints on couplings and condulets, provides complete protection against corrosive fumes. There is no "corrosion travel", no fume seepage.

Plasti-Bond's unique protection costs less installed than any other effective corrosion-resistant electrical system. *Standard conduit installation methods and tools are used with little or no alteration in technique.*

Complete corrosion-proof conduit systems can be specified in Plasti-Bond, including *Crouse-Hinds* condulets, lighting fixtures, straps, and pull boxes to meet all requirements.

Get the full story on the finest PVC-protected electrical system. Write today.

\*Patent Pending



**PITTSBURGH  
STANDARD**  
CONDUIT CO.

GENERAL OFFICE: VERONA, PA.

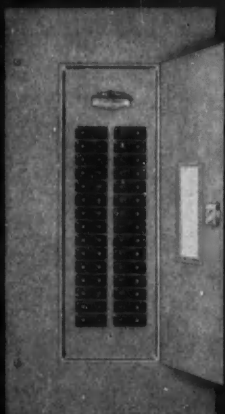
Plant: Verona, Pa. • Monaca, Pa. • Houston, Pa.  
Franklin, Pa. • Gilmer, Tex.





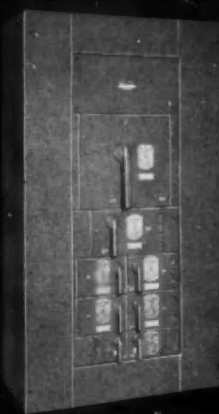
## ELECTRICAL EQUIPMENT

*The Industry's Best Buy In  
Safety, Performance, Durability*



### LIGHTING PANELBOARDS

Plug-In or Bolt-On Circuit Breaker Types.



### S-A-W DISTRIBUTION PANELBOARDS

Last Word in Heavy Duty Fusible Protection.



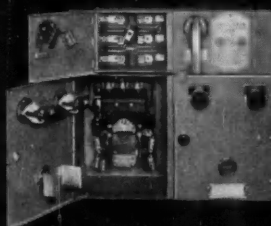
### POWER PLUG-IN BUSDUCT

Plug-In Outlets 10" Centers.  
250/1500 Amps., 600-V. AC.



### MIDGET BUSDUCT

Extends Busduct System for Less Than Wire, Cable  
and Labor Costs. 100 Amps. Unfused, Fusible or  
Breaker Plug-In Units.



### NON-COMBINATION

Starter and Fusible Switch  
Assembled.



### COMBINATION

Single Enclosure With  
Starter and Switch or  
Starter and Breaker.

### PLUG-IN MOTOR STARTER UNITS

Plugs into Panelboards or Switchboards.  
Eliminates Separate Motor Controls.

No matter what the size and complexity of the project—no matter if the need is for the largest switchboard or the smallest safety switch—the Frank Adam name upon it is a warranty of unsurpassed quality and craftsmanship, protection and durability.

Give your clients every benefit in safety, dependability and economy of the "industry's finest"—specify, insist on, Frank Adam Electrical Equipment.

Write for catalog literature



SINCE 1891

**FRANK ADAM ELECTRIC COMPANY**

P. O. BOX 357, MAIN P. O. • ST. LOUIS 66, MO.

busduct • panelboards • switchboards • service equipment • safety switches • load centers • Quikmeter





# Here's why you can always bet your life

When an Onan Electric Plant rolls off the production line, we rarely know what its end-use will be. It could provide life-or-death power for an iron lung. Or Civil Defense communication. Very possibly, it could wind up on the job for you.

But we do know that every Onan Plant can be depended upon to perform satisfactorily under the most demanding applications . . . yours or any other users.

## **Every Unit is Tested under Full Load**

We know every Onan Plant will deliver every watt of

power the nameplate promises because each and every Onan is run-in and tested for several hours under full-load before it leaves the factory.

At any given time, you'll find more than 100 Onan Plants—all sizes, 500 watts to 230 kw—in the huge test bank illustrated. Then, as a double-check on quality, Onan has an independent testing laboratory engineer run periodic re-checks to confirm Onan's own tests and testing procedures. If a single Plant slips through production with a "bug" in it, it's caught. *You never get a "lemon" when you specify Onan.*





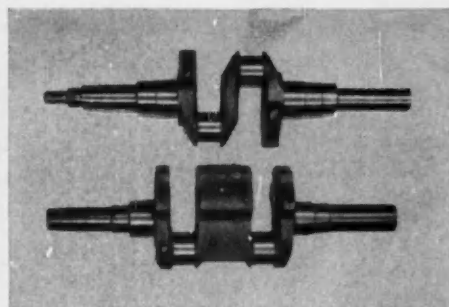
# on an Onan plant

## Factory Service Available Locally

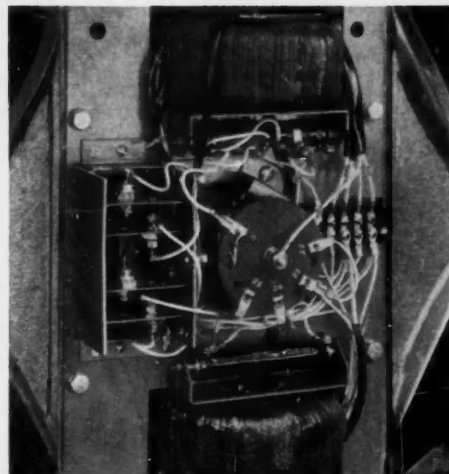
You'll find factory-trained Onan distributors in every major city, fully qualified to offer installation and service help. Before you buy, investigate Onan. Look in the Yellow Pages.

Only Onan is Performance Certified to give you every bit of power the nameplate promises.

ONAN Division, Studebaker-Packard Corp., 2570 University Ave. S.E., Minneapolis 14, Minn.



Onan's bigger, stronger crankshaft, compared to typical competitive part, typifies the extra ruggedness Onan builds into all Electric Plants.



Onan's exclusive Magneciter generator is static excited to eliminate rotating exciter and mechanical regulator. Moving parts are eliminated in both exciter and regulator. Voltage recovery is five times faster than brushless type generators.

## PERFORMANCE CERTIFIED

We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.



# 9000

△ HOURS OF LIFE



## Fluorescent Breakthrough!

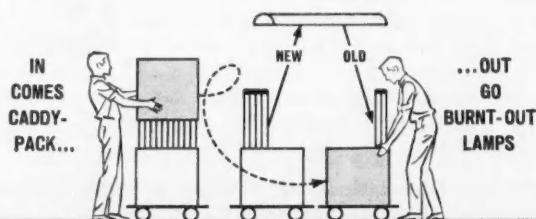
### New Sylvania 9000-hour "LIFELINE" lamp lasts 20% longer

It's another spectacular first from Sylvania — world's pioneer in fluorescent lighting! Now, average rated life of standard Sylvania 40-watt fluorescent leaps from 7500 hours to an unheard-of 9000 hours in new "Lifeline" series. That's almost 4 years . . . at 40 hours of weekly use. No other 40-watt fluorescent on the market — not even a premium lamp — can equal this performance.

What's more, this new Sylvania lamp uses less power than other standard lamps. Can save you as much as 3% on your electric costs. And to cap this amazing performance, it delivers a rated 3100 lumens.

Any wonder this sensational new Sylvania fluorescent stands out in every value analysis? And now with 60 of these 9000-hour "Lifeline" lamps safely packed in ingen-

ious new Sylvania Caddy-Packs (the top is specially designed as a receptacle for replaced tubes), group relamping with Sylvania becomes faster, safer, more economical than ever!



CADDY-PACK MAKES GROUP RELAMPING EASIER THAN EVER!



# 7500

▽ HOURS OF LIFE

## than standard fluorescents...costs not a penny more!

These are just two new ways Sylvania gives you lowest TCL—Total Cost of Lighting. And only Sylvania backs it all up with an exclusive money-back guarantee.\*

Specify Sylvania 9000-hour "Lifeline" lamps next time

you order. For more details, write Sylvania: Lighting Division, Sylvania Electric Products Inc., Dept. 15, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., Montreal.

\*"If at any time a Sylvania Fluorescent Lamp fails in your opinion to provide better performance than any other brand fluorescent lamps, on the basis of uniformity of performance, uniformity of appearance, maintained brightness and life, it may be returned to the supplier for full refund of purchase price."

# SYLVANIA

SUBSIDIARY OF  
**GENERAL TELEPHONE & ELECTRONICS**

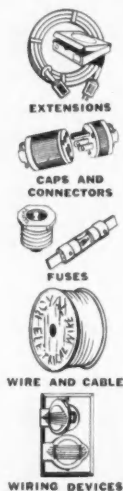




IN HEAVY-DUTY EXTENSIONS

...THE ROYAL "**POWR-KORD**" FAMILY IS  
YOUR SUREST SOURCE OF SATISFACTION!

Whatever your specifications, you'll find that ROYAL heavy-duty CORDS PROVIDE THE READY ANSWER. *Ratings?* 15 amp — 125V ... 10 amp — 250V ... 20 amp — 250V ... 10 amp — 600V. *Conductors?* 2 or 3, standard ... 4, special. *Jackets?* Rubber or vinyl with molded-on caps and connectors to match. *Colors?* Red, black or yellow. *Wire types?* S, SJ or SJT. *Wire sizes?* 10, 12, 14, 16 or 18. *Cord lengths?* 10, 15, 25, 50, 75 or 100 feet. *Packaging?* The best in the business — easy to stock ... so easy to sell. Place your order for Royal "Powr-Kords" with your Royal wholesaler today.



**ROYAL**  
ELECTRIC   
... an associate of

ROYAL ELECTRIC CORPORATION  
PAWTUCKET, RHODE ISLAND



# How to select a Remote Control Switch

Electrical engineers are increasingly incorporating Remote Control Switches into their wiring layouts and circuits. Remotes today are used not only for the instantaneous control of emergency equipment, where they are a *must*, but for safety, economy and convenience wherever light or power is being distributed over a wide area.

## Selection of Type

The selection of the right remote for a particular application must be given some study, but basically there are only two factors which affect the selection of type: (1) the class of load: non-inductive, such as heaters and lighting; or inductive, such as motors; (2) the voltages of the systems used.

## Mixed Loads

Where there are mixed loads, non-inductive load rating must not be less than the combined full-load currents nor less than 66⅔% of the maximum current to be interrupted.

Any connected motors should be evaluated on the basis of stalled rotor current, using the multiplier of six times motor current if the actual value is not known. These currents added to the non-inductive load current will establish the maximum current which the switch will have to interrupt. In specifying the switch capacity, give class of the load and the amount of the load which is to be controlled.

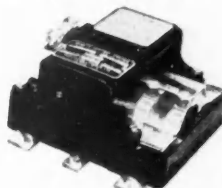
## Why Mechanically Held

Another important selection-factor is that the remote control switch be mechanically held. Because it is essentially a feeder disconnect, the remote must be unaffected by line voltage conditions and respond only to control of the push buttons. ASCO mechanically held remotes insure against outages on vital circuits caused by momentary line voltage dips.

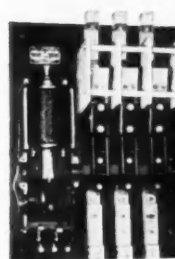
A detailed report on the advantages of ASCO remote control switches can be obtained by writing for new catalog 57-S2.

## A selection of basic Remote Control Switches by ASCO

### For Economy and Rugged Construction...



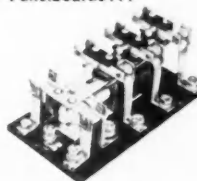
Use the Bulletin 920—Up to 3 Poles, Single Throw, 30-75 Amps D-C, 30-200 Amps A-C. U.L. Approved to 600V A-C, 250V D-C. Recommended for all loads within its capacity range.



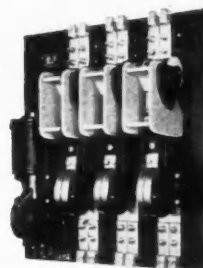
For Load Requirements Exceeding Capacity of the Bulletin 920...

Use the Bulletin 910—Up to 4 Poles, Single Throw, 30-400 Amps, 250 volts, A-C.

### For Small Panelboards...



Use the Bulletin 909—Up to 5 Poles, Single Throw, 3 Poles, Double Throw, 30 Amps, 250 volts, A-C or D-C.

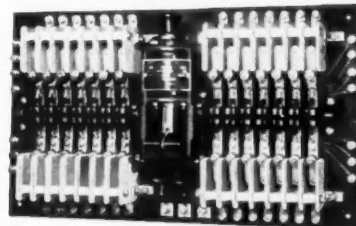


For High Capacity, Highly Inductive Loads...

Use the Bulletin 911—Up to 4 Poles, Single Throw, 30-1000 Amps, 600 volts, A-C, 250 volts, D-C.

### For Multiple Pole Requirements...

Use the Bulletin 915—Up to 24 Poles, Single or Double Throw, 30, 60 and 100 Amps, A-C.



# ASCO Electromagnetic Control

**ASCO**

DEPENDABLE CONTROL BY Automatic Switch Co. 50-J HANOVER RD., FLORHAM PARK, N. J. • FRONTIER 7-4600 • AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL



PMF-104A Post-mounted Fluorescent Luminaire (12-20' mtg. hgt.)



P-400 Mercury Powerflood Luminaire, also P-1000 size (25-35' mtg. hgt.)

## New lighting efficiency...

Take a new look at shopping centers, motels, and parks . . . industrial plants and commercial buildings . . . recreational areas, funspots, and country clubs. Today, wherever Americans work and play, modern outdoor area lighting is being used to complement the daytime beauty of modern facilities and to enhance their appeal and usefulness at night.

To help you meet this new trend, here is part of the spectacular new General Electric area-lighting line—combining smart appearance design and highly efficient lighting performance.

New, style-leading G-E area lighting features the futuristic PMF-104A fluorescent unit and the ultra-modern PMA-115 mercury post-top unit—

both in a choice of decorator colors—for entrance roads, walkways, and malls. Other frontrunners include the compact Powerflood mercury unit and Quartz-Flood unit for quartz lamps—used in sports, recreation, and industrial lighting.

Choose from dozens of fixtures, in a full range of ratings and sizes, and a complete line of poles, mountings and hardware. They're all shown in a new G-E "Designer's and Buyer's Guide for Area Lighting" (Publication GEA-7223). The new 1962 edition includes application data, guide-form specifications, plus easy-to-use ordering information. Everything is at hand to help the architect-consultant-contractor team serve clients promptly and efficiently.





QF-1500 Quartz-flood Luminaire,  
also QF-500 size (25-35' mtg. hgt.)

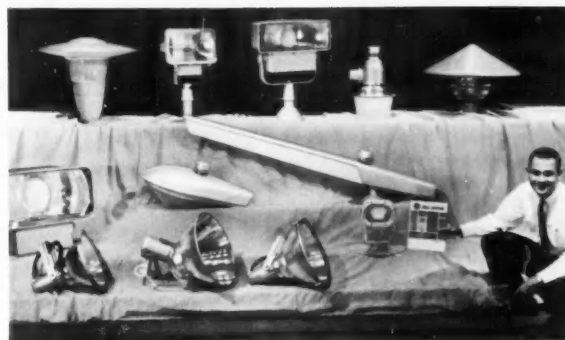


PMA-115 Post-mounted Filament or Mercury Luminaire

## striking beauty day and night

Products, service, and copies of this Area Lighting Guide are available locally from your G-E Sales Engineer or Area Lighting Agent. If you prefer, write for your Guide to Sect. 460-17, General Electric Company, Schenectady, N. Y. Outdoor Lighting Dept., Hendersonville, N. C.

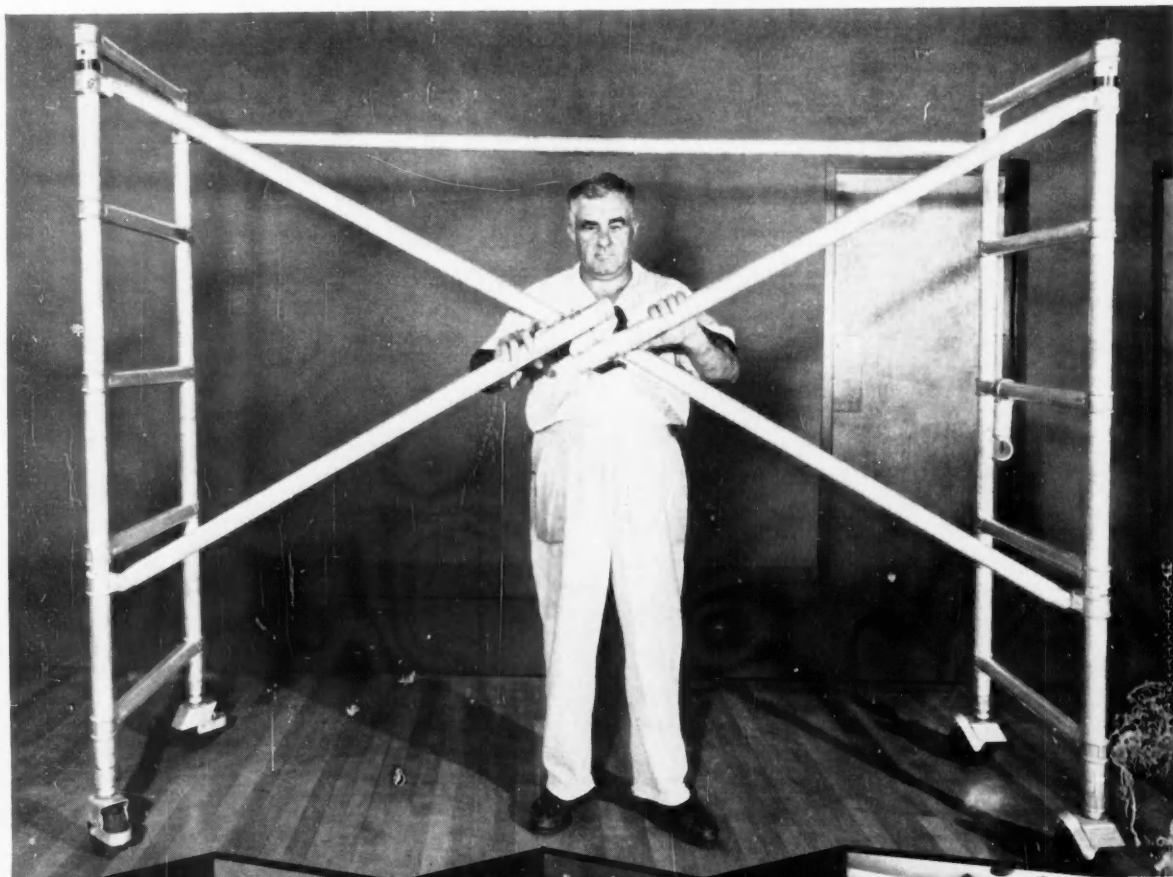
YOUR G-E AREA LIGHTING AGENT—backed by your G-E Sales Engineer—offers prompt shipment from local stocks, and valuable local service. Ask them about America's newest, most complete area-lighting line and your copy of the "Designer's and Buyer's Guide."



*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

# New one-piece scaffold unfolds and locks into shape in 10 seconds!



No tools required. No nuts, bolts, loose parts—nothing can be left out or lost! Platform height adjustable from 1 ft. to 8½ ft. Instantly adjustable legs. Lightweight aluminum: can be carried up stairs by 1 man. Compact: stores in same space as a step ladder. Interchangeable with all Up-Right span scaffolds in use.

## UP-RIGHT ALUMINUM VX SCAFFOLD

Write for circular: **UP-RIGHT SCAFFOLDS, Dept. 104, 1013 Pardee, Berkeley, Calif.**

In Canada: Up-Right Scaffolds Ltd., 120 Russett Ave., Oshawa, Ontario

NEW  
TWO-HIGH  
**SPACE  
MAKER**  
HIGH-VOLTAGE  
CONTROLLER



SpaceMaker is an Allis-Chalmers trademark.

the only real drawout 2- to 5-kv controller...with a  
contactor you can get at, into, around...without tools

▲ This means no unbolting—no wires to unfasten. You rack the contactor to "disconnect position" with the door closed. Open door. Roll contactor carriage out. It's that simple, that quick . . . and safe. ● Inspection? Lift out arc chutes and barriers. Rotate pole pieces to fully expose contact structure. Fuses? Lift them out, too. No tools, all the way. ■ SPACEMAKER control. First dramatic new achievement in high-voltage motor control in more than a decade. To learn more about the many cost-cutting features, call your A-C distributor or representative. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

LET'S COMPARE THESE FEATURES

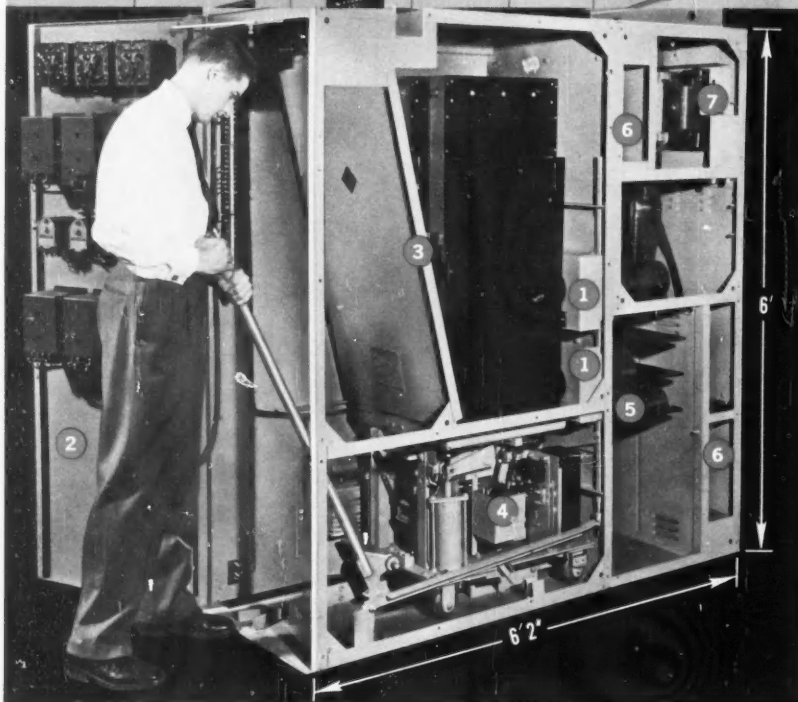
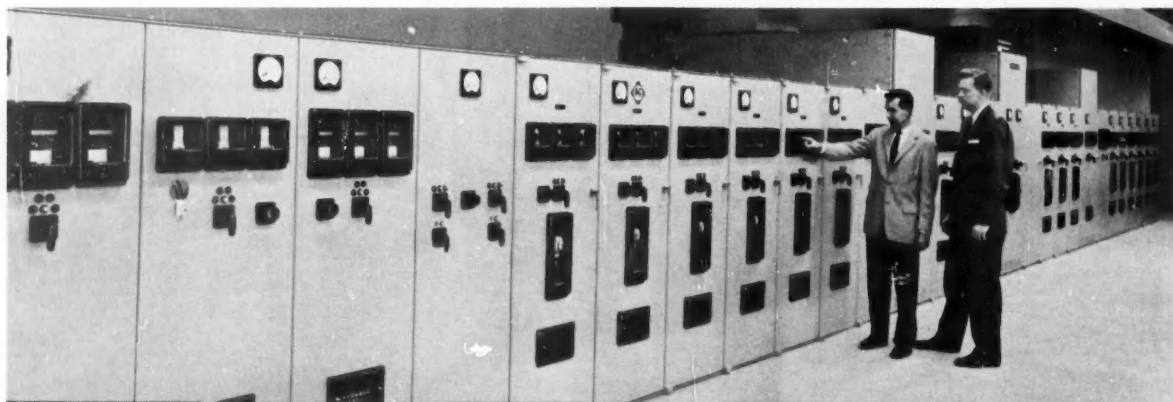
	SpaceMaker Controller	Controller "A"	Controller "B"
Two starters in 90" height	Yes	No	No
Drawout construction	Complete	Partial	No
Simultaneously disconnects all six main leads (line and load)	Yes	Line Only	Line Only
Automatic shutters isolate line	Yes	Yes	No
"No-tool" inspection of contacts	Yes	No	No
Track-resistant, flame-retardant insulation	Yes	No	No
Contactor construction	Double Break	Single Break	Single Break
Overload relays visible from outside	Yes	No	No

**ALLIS-CHALMERS**



A-1521

# ALLIS-CHALMERS



4.16 kv metal-clad equipment serving a west coast city.

1. Separate compartments for current transformers.
2. Full panel metering and relaying.
3. Double-lock panel for operator safety.
4. Easy service accessibility without dismantling.
5. Glass polyester insulation throughout.
6. Separate up-feed and down-feed cable compartments.
7. Fully cast, trunnion-mounted potential transformers.

## Lowest height, easiest access

the only switchgear with fully isolated current transformers

The front-accessible current transformers can be inspected, maintained or replaced without exposure to any high voltage compartment. A-C metal-clad units are just 72 inches high — means eye-level instrumentation . . . shoulder-height accessibility of component parts. And the entire panel can be used for meters and relays. Maximum compartmentation and dead-front construction offer greater safety. Buswork and components arranged for easy addition of future units.

You get rapid, one-stroke insertion of the circuit breaker. The breaker has glass polyester insulation for highest impulse strength . . . the only self-locking protective barrier . . . four-bar linkage is mechanically, electrically trip-free. Primary disconnect fingers eliminate use of garter springs, and are on the circuit breaker for easy inspection. Both stored energy and solenoid operators are available. For more switchgear information contact your nearby Allis-Chalmers office. A-1457



**B.F. Goodrich**

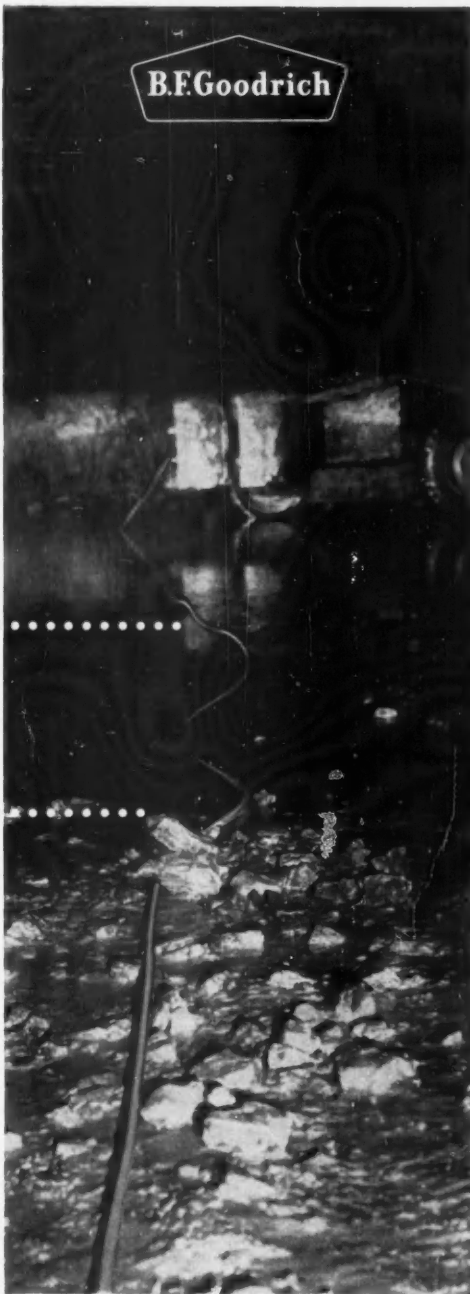
**Geon  
insulated  
mine cable  
laughs  
at water.....**

**and  
sharp.....  
edges**

**stands up under  
heavy machinery  
...won't burn**

The Geon vinyl insulation on this mine cable is unique because it provides electrical and mechanical protection in a single homogeneous covering. The use of vivid color adds a valuable safety factor. Due to its toughness, this insulation stands up where other materials break down.

This remarkable new covering of Geon vinyl keeps out water and moisture, slips unharmed over jagged rocks and through crimping crevices, resists damage when



Picture taken in U. S. Gypsum Company mine at Oakfield, New York, shows cable made by Coleman Cable & Wire Company, River Grove, Illinois, who use Geon, by B.F. Goodrich Chemical Company.

the job—no need for complicated vulcanizing equipment.

Fire is no threat to Geon, because this versatile material won't burn. Learn how you can benefit by using cable protected with Geon vinyl. Write Department AL-1, B.F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

run over by heavy machinery.

As a result, time and money are saved because cable failures come much less often. When they do, splicing is easier and faster because it can be done right on

**B.F. Goodrich Chemical**

a division of The B.F. Goodrich Company



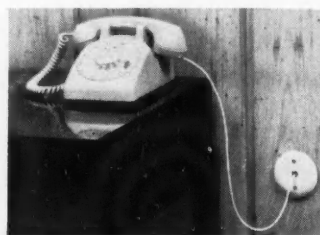


This five-bedroom ranch home is located in Glendale, Wisconsin, one of Milwaukee's most beautiful residential suburbs.

## In Milwaukee, Wisconsin, this house sold for \$41,500

*("...and conveniences like concealed telephone wiring helped me sell it," says builder Jerre Allen)*

"I discovered a long time ago that the buyer of the higher priced custom home expects to find *every* convenience built into the house. And one of the best of these custom conveniences is concealed telephone wiring. That's why we provide outlets wherever they might be needed. Just yesterday, for instance, we put outlets in every room of a 12-room house. My buyers respond very favorably to this sort of planning. They know how it pays off in a better looking, more functional home. I wouldn't overlook pre-wiring for telephones in any home I build."



Your Bell Telephone Business Office will help telephone-plan your homes. For details on home installations, see Sweet's *Light Construction File*, 11c/Be. For commercial installations, Sweet's *Architectural File*, 33a/Be.

**BELL TELEPHONE SYSTEM**





# COLD WEATHER

# ?



## FREE SAMPLE! REG. U.S. PAT. OFF. **SCOTCH** BRAND ELECTRICAL TAPE No. 88 **FIRST ALL-WEATHER ELECTRICAL TAPE**

Now at last a "super" tape to handle the toughest cold weather splicing jobs. New "SCOTCH" BRAND Electrical Tape No. 88 is 20% thicker than ordinary plastic tapes. Retains its easy handling properties and "feel" under all temperature conditions. UL approved. Resists acids, abrasion, alkalies, oils and weathering. Send in the coupon for free 9 ft. sample roll.

Made by the makers of "SCOTCH" BRAND No. 33 Electrical Tape.

----- SEND IN TODAY -----

3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. EAA-12  
Send me a free sample roll of "SCOTCH" BRAND Electrical Tape No. 88

NAME

COMPANY

ADDRESS

CITY  STATE



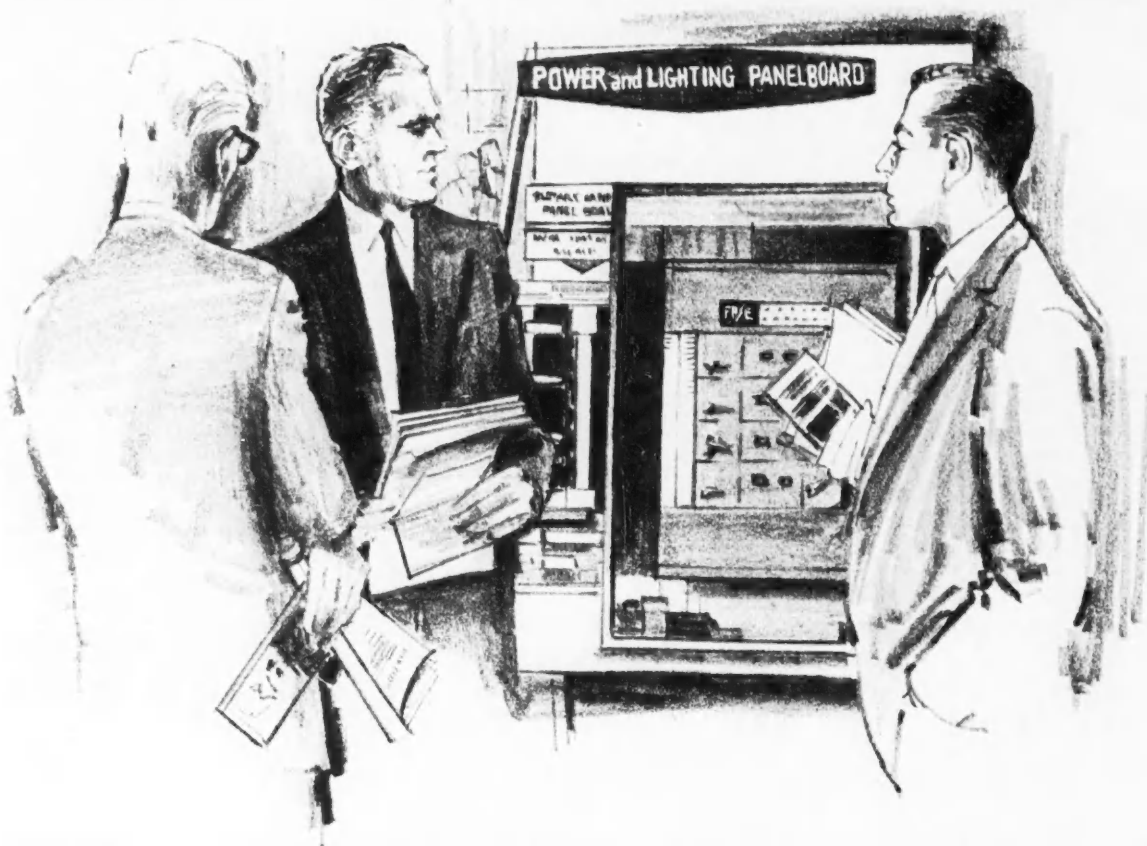
MINNESOTA MINING & MANUFACTURING CO.

Electrical Products Division

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.

# 6<sup>th</sup> NATIONAL ELECTRICAL INDUSTRIES SHOW

profit by attending



**6th National Electrical Industries Show—the only all-exclusive, all-purpose industries show dedicated solely to electrical construction materials and apparatus.**

If you are in any way a part of specification, distribution, installation, or maintenance in the electrical industry, you will want to attend the National Electrical Industries Show in New York, at the Coliseum, March 11-14, 1962.

Here is the golden opportunity to educate yourself to everything new and important by meeting and talking to the men who design and manufacture the products you specify and use.

## **THE KEY TO THE ELECTRICAL INDUSTRY**

At the 6th National Electrical Industries Show, you will profit by visiting almost 2 acres of exhibits, approximately 300 displays, 1,000's of the latest products in the electrical construction materials and apparatus field.

Remember—the 6th National Electrical Industries Show is the only major electrical exposition in 1962.

Over 25,000 electrical men will attend this show, from Maine to California. See that your company is fully represented. Benefit by visiting the only show in America geared to profiting qualified electrical men.

## **6<sup>th</sup> NATIONAL ELECTRICAL INDUSTRIES SHOW, NEW YORK COLISEUM, MARCH 11, 12, 13 & 14—1962**

For travel, hotel reservations (group and singular), and for additional information, write:

**NATIONAL ELECTRICAL INDUSTRIES SHOW** 477 Madison Ave. New York 22, N.Y. Phone: PLaza 2-5190  
Sponsored by EEWA — Eastern Electrical Wholesalers' Association



# NEW PENNSYLVANIA THREE-PHASE POWER SUPPLY CENTER

**for shopping centers,  
industrial plants, schools**

Pennsylvania's new three-phase Power Supply Center is specifically designed for use with underground primary feeders, in applications ranging from 750 through 2500 kva, 15 kv and below. At shopping centers and other commercial areas, small industrial plants and schools, it permits the elimination of unsightly fences and overhead structures without the expense of underground vaults. Appearance can be further enhanced by the addition of shrubs and trees, or by other landscaping.

## **All live parts enclosed**

The Power Supply Center requires less space, too . . . may be installed immediately adjacent to buildings. It is available in either standard transformer gray or forest green.

Live parts are completely enclosed in weatherproof, tamperproof compartments with padlocking facilities. To protect utility personnel, standard load-center accessories are located inside the low-voltage compartment.

The standard Power Supply Center is built to accommodate primary cable from underground, with either top or bottom cable entrance on the secondary.

Optional accessories are also available at additional cost—including provisions for bus duct entrance on the secondary, potheads, lightning arresters, fuses, and provision for the utility's metering equipment. A complete list of accessories is on back of this page.

## **Low initial cost . . . long-range economy**

*Initial cost* of Power Supply Centers reflects a concentrated effort on the part of Pennsylvania Transformer's engineers and production specialists to provide high-quality standardized units at the lowest cost consistent with realistic business considerations.

For your convenience in ordering or computing costs, prices of standard Power Supply Centers are on the back of this page. Complete information regarding the cost of optional items also is included.

*Long-range economies* result from the elimination of normal maintenance costs for fences and overhead structures. Also, there is less likelihood of damage from the elements . . . and less chance of service interruptions.

**See other side for more details  
and complete pricing information**

# **PENNSYLVANIA TRANSFORMER DIVISION**

McGraw-Edison Company

Canonsburg, Pennsylvania



# FACTS and FIGURES on Pennsylvania's Power Supply Center for shopping centers, industrial plants, schools

**Designed for low initial cost . . . long-range economy**  
Prices for the *standard* Power Supply Center should be particularly attractive to users because of the

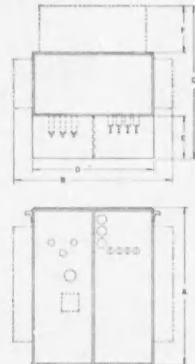
manufacturing economies standardization makes possible. Optional features and accessories are available at additional cost to meet special requirements.

## STANDARD POWER SUPPLY CENTER . . . Ratings, Dimensions, Weights, Prices

High Voltage* (Delta only)		Low Voltage	KVA	DIMENSIONS—In Inches						Total Weight Pounds	NET PRICE†	
Volts	BIL (kv)			A	B	C	D	E	F		Eastern Zone	Western Zone
2400	45	480/277 480 Δ 600 Δ	750	89½	80	70⅞	58⅞	20	18⅞	10,800	\$5,665	\$5,835
4160	60		1000	94½	92	74⅞	62⅞	20	22⅞	12,800	6,605	6,803
4800	60		1500	100½	100	79⅞	62⅞	20	26⅞	16,200	8,800	9,064
6900	75		2000	110½	105	85⅞	67⅞	20	30⅞	19,700	10,710	11,031
7200	75		2500	125½	116	90⅞	70⅞	20	34⅞	24,800	12,157	12,521
12000	95	208Y/120	750	89½	80	70⅞	58⅞	20	18⅞	10,800	6,030	6,210
13200	95		1000	100½	92	74⅞	62⅞	20	22⅞	13,800	7,050	7,262
13800	95											

\*Standard taps—2 above and 2 below

†Freight allowed to railroad siding nearest destination.



### STANDARD FEATURES AND ACCESSORIES

Prices quoted above include isolated high- and low-voltage terminal compartments, with hinged doors . . . provisions for cable entrance . . . and load center transformer (55°C rise, standard impedance, oil-immersed) with the following accessories:

3 high-voltage bushings (15 kv)	Dial-type thermometer
4 low-voltage bushings (1.2 kv)	Pressure-vacuum gauge
Permanently welded radiators	Welded-on handhole cover
Welded-on cover	Filter press connection
Tap changer for de-energized operation (with provision for padlocking)	Drain and bottom filter valve with side sampling device
Lift lugs	Formed base with provision for jacking, skidding, rolling
Liquid-level gauge	Connection diagram nameplate
	Stainless-steel ground pad

### OPTIONAL FEATURES AND ACCESSORIES

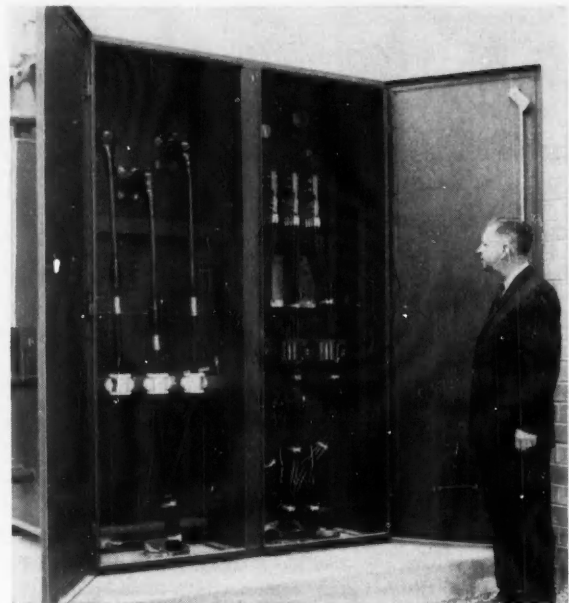
The following items are available at additional cost, as stated:

#### High Voltage:

Fuses (3 SM4, with S&C Loadbuster feature) . . . . .	\$600
Potheads (1 3-conductor or 3 1-conductor) . . . . .	\$320
Lightning arresters (set of 3) . . . . . 3 kv, \$70; 6 kv, \$100;	
9 kv, \$135; 12 kv, \$165; 15 kv, \$225	
Provisions only for lightning arresters . . . . . 3 or 6 kv, \$25;	
9, 12 or 15 kv, \$40	

#### Low Voltage:

Provision for bus duct connection . . . . . 1600 amps., \$405;	
2000 amps., \$635; 3000 amps., \$1060; 4000 amps., \$1425	
Provision for mounting utility's metering transformers. \$150	



Open compartment doors permit view of one utility's method of connecting the Power Supply Center. The unit is 750 kva, 13,800Δ—216Y/125 volts.



Address orders and inquiries to: Switchgear Sales

## PENNSYLVANIA TRANSFORMER DIVISION

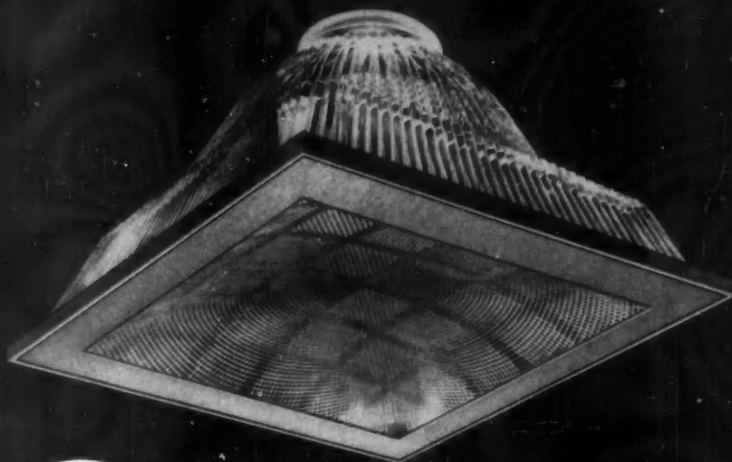
McGraw-Edison Company      Canonsburg, Pennsylvania

<<<Turn to preceding page for complete picture of Power Supply Center's advantages

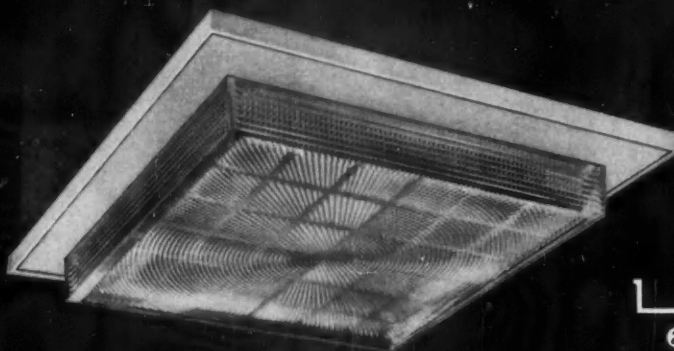


## OPTICAL TRAIN

... In PAL Luminaires the prismatic glass reflector is precisely designed to coordinate with the Controlens (any, one of three interchangeable contours). Prismatic control assures total luminosity, complete absence of glare.



# Your Choice of **3** CONTROLENS® in Holophane \*PAL® Luminaires



1 CONCAVE

2 DROPPED TRIM

3 PLANE

\*Positive Automatic Latching



## Flexibility for Versatility

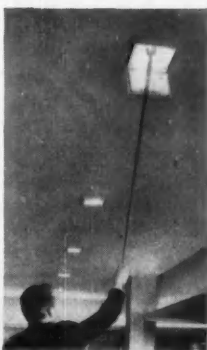
**Designer's Choice** . . . Three prismatic lenses with different contours — "concave", "dropped trim" and "plane"—permit an unusually broad scope of design expression. Luminaires can be applied as individual tile-fitting units or as matched combinations, 2 in line or 4 square.

**Engineer's Preference** . . . The optical train consistently produces the highest lighting performance, directing maximum illumination where it is most required. Wide range of possible lighting levels—choice of 150, 200 or 300 Watt lamps.

**Budget-Maker's Selection** . . . Positive Automatic Latching works simply for quick, low cost relamping and servicing—push against lens to open, push against trim to close. . . . Glass components are easy to clean, eliminate deterioration. PAL Luminaires are economical to install and maintain.



PAL Installation in  
MACY's, (N.Y. Dept. Store)



Positive Automatic  
Latching Works Simply

Write for engineering data.

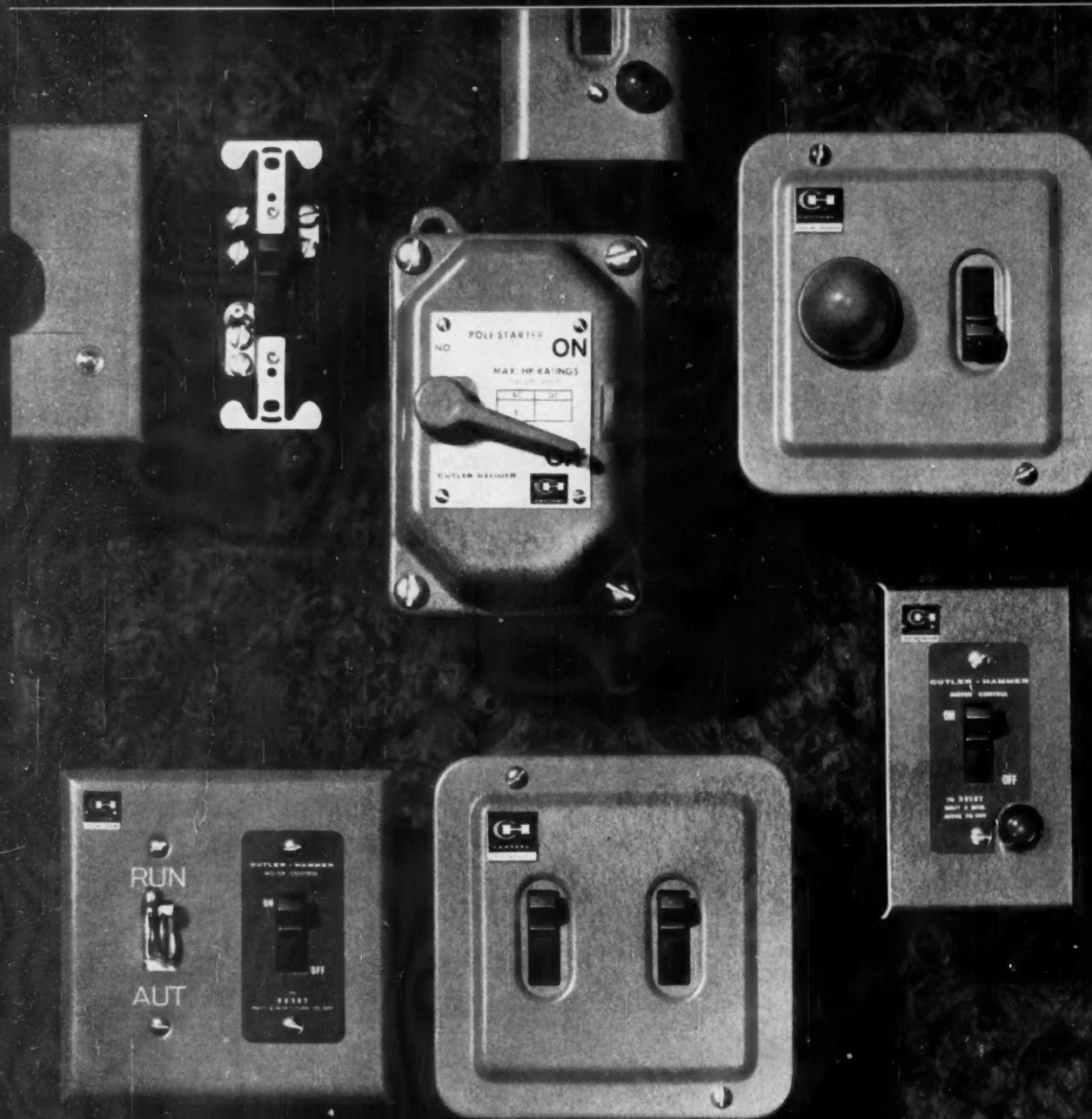
**HOLOPHANE COMPANY, INC.**

Lighting Authorities Since 1898

342 Madison Ave., New York 17, N. Y.

THE HOLOPHANE CO., LTD., 418 Kipling Ave. SO., TORONTO 18, ONT.





## Complete line! Now with NEW 2-speed

**Immediately available from stock.** Cutler-Hammer Manual Starters will stop, start and protect all types of fractional horsepower A-c or D-c motors on all types of electrically driven equipment. To meet your needs completely, new key and lever operated starters have been added.

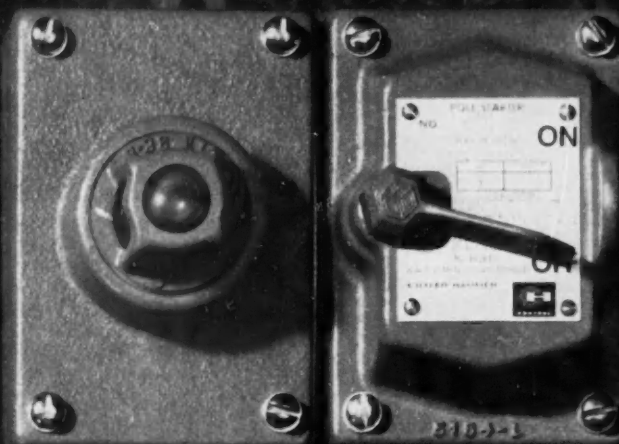
Also added to the new line is another Cutler-

Hammer exclusive: the only two-speed starter which provides separate overload coils for high and low speed positions specifically fitted to the amperage involved at either speed.

Call your Cutler-Hammer sales office or distributor for a demonstration. Or, write for Bulletin LJ-86-A241.



NEW from  
CUTLER-HAMMER



*Above, new 2-speed and key and lever operated MANUAL STARTERS*

## knob-operated manual starter

WHAT'S NEW? ASK . . .

**CUTLER-HAMMER**

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Cutler-Hammer, Canada, Ltd.; Cutler-Hammer, Mexicana, S. A.



# WHEELER

# 8600

LINE

## V-25



## QUALITY FOR FEWER DOLLARS

CHECK THESE 8600 LINE FEATURES!

1. Increased "seeability" with high level lighting. Through re-designed lamp positioning, the 8600 Line offers new shielding angles up to 34°, providing better light distribution and greatly increased eye comfort.
2. Fused porcelain enamel reflectors have *turned-in* edges. This exclusive Wheeler design prevents the collection of dust, lint, and moisture common to all fixtures with "out-turned" edges. Maintenance is easier.
3. Upturned diffuser slots not only provide 25% uplight but promote free air circulation. This "chimney effect" is a self-cleaning action and enables the cooler lamps to give greater light output.
4. Fixture shown is the "V-25" which has 30° shielding and 25% uplight. The "F-20" has flat reflectors providing 15° to 18° cross-wise shielding as well as uplight. The "P-30" has a plastic Krystalens offering almost total lamp shielding, while utilizing the uplight feature.
5. All Series 8600 units are available with Slimline, Rapid Start, Bi-Pin, 800 and 1500 ma lamps. Plastic prismatic lenses, louvers and wire guards are among the accessories offered.



Due to careful engineering and manufacturing ability, we are able to offer these units at extremely attractive prices.

Send today for new four-page color brochure

**WHEELER REFLECTOR** Company • Division Franklin Research and Development Corp.  
MAIN STREET, HANSON, MASSACHUSETTS



# Only BURNDY offers all three!

## THERMOWELD® — COMPRESSION — BOLTED

# thermOweld



Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.



Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.



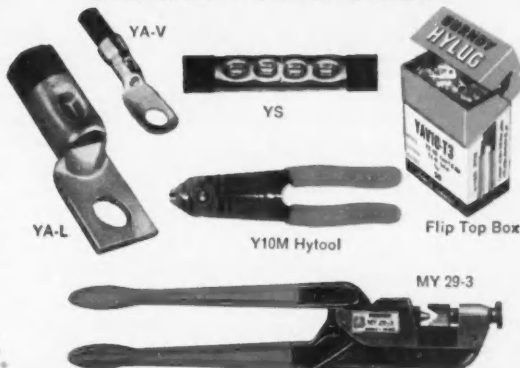
Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.



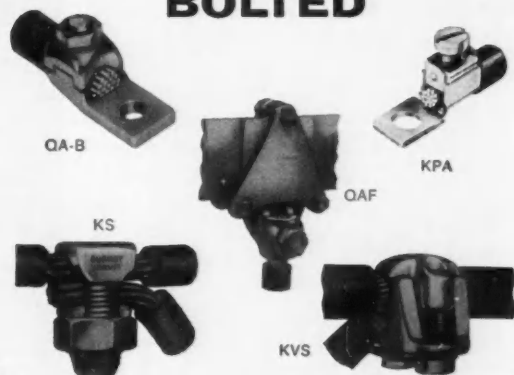
Welds a permanent electrical connection easily and economically to any copper conductor or steel structure.



### COMPRESSION



### BOLTED

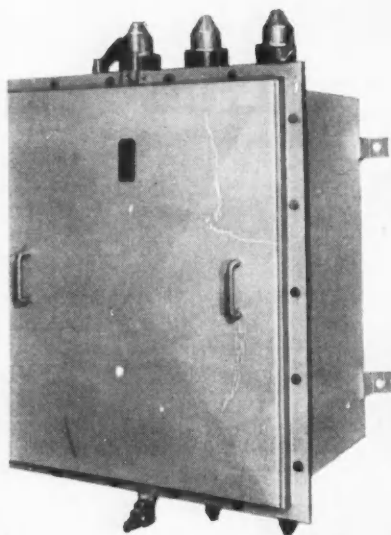


AVAILABLE AT YOUR BURNDY DISTRIBUTOR

# BURNDY

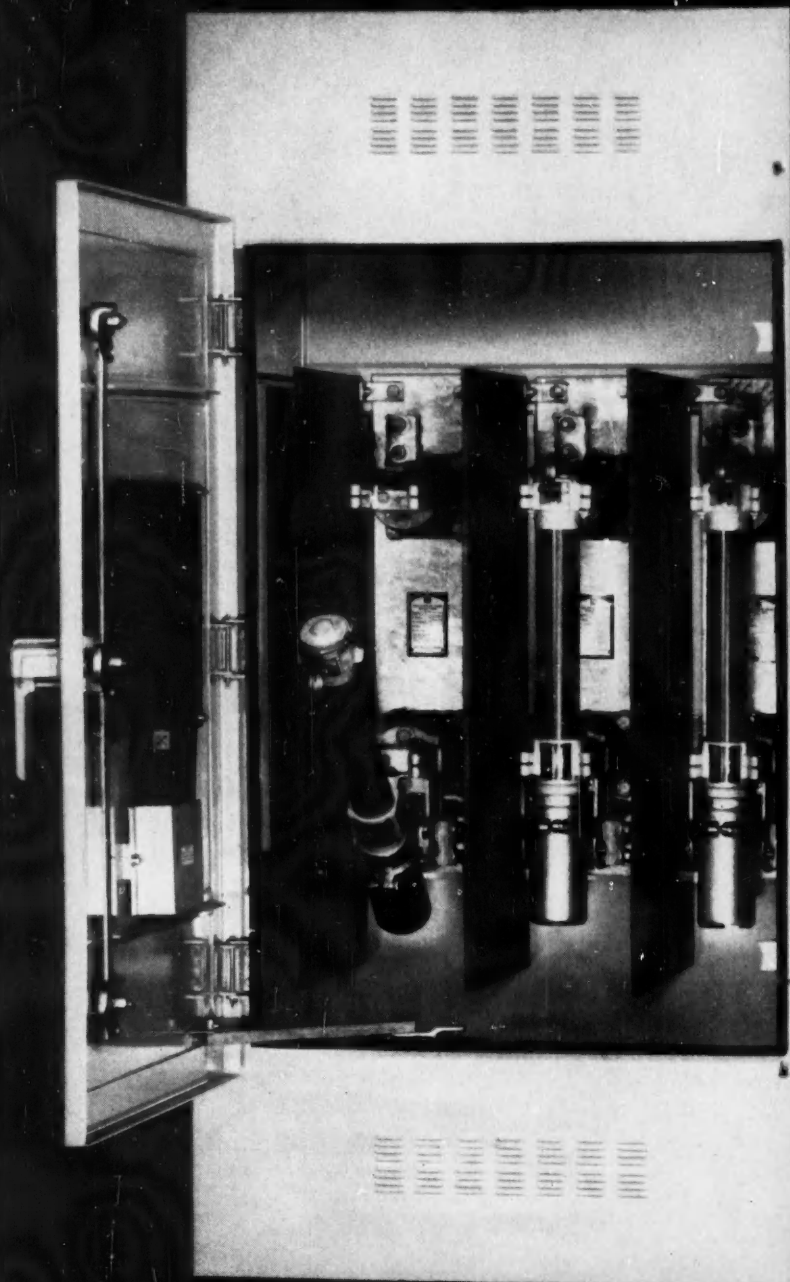
NORWALK, CONNECT. BICC-BURNDY Ltd. Prescott, Lancs., England In Europe: Malines, Belgium TORONTO, CANADA

**Who ever  
heard of  
hanging  
500,000 kva  
on a wall?**



▲ Submersible style for use in basements or vaults where flooding is a possibility.

▶ Indoor-outdoor style for general application where there is no possibility of flooding.





## Do it with S&C's new line of high-voltage metalclad fuses for wall mounting

Here is a steel-enclosed fuse that gives you economical and fully adequate high-voltage fault protection for small loads:

1. At service entrances;
2. On transformer primaries;
3. At underground sectionalizing points.

S&C's new line of metalclad fuses combines economy with high fault interrupting capability. Their compactness permits wall mounting, eliminating the floor area requirements of conventional free standing metalclad switchgear. And much less room height is needed.

These fuses are especially suited to applications that justify fault protection *only*—applications where infrequent load switching (and isolation for rare fuse replacement) may be done elsewhere.

To permit you to tailor the new S&C Metalclad Fuse—Type SM to your particular requirements, a complete selection of features and ratings is available:

- Indoor Style, Indoor-Outdoor Style, or Submersible Style
- 4.8 kv or 14.4 kv
- 200E or 400E continuous amperes
- Cable entrance by knockout, flange-mounted pothead (1/C or 3/C), or integral pothead (1/C)
- 45,000 kva to 500,000 kva fault interrupting, in convenient steps

For further information, call your nearest S&C Sales Office. Consult the Yellow Pages under "Electrical Equipment" for the telephone number and address in all principal cities.

## S&C ELECTRIC COMPANY

4433 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911



# SYLVANIA LIGHTING WITH MULTI-LAYER *polRized* IMPROVE VISUAL



## THE RESEARCH

In 1958 H. Richard Blackwell, Ph.D.,\* reported the results of an 8-year study\*\* to determine the amount of illumination required for the human eye to perform various seeing tasks. These findings served as a basis for The Illuminating Engineering Society's official Recommended Footcandle Levels for all types of Visual Tasks.

In the original report, Dr. Blackwell indicated that his work had been performed under ideal glare-free conditions.

A second report by Dr. Blackwell\*\*\* specifically on the subject of reflected glare was presented to the National Technical Conference of the Illuminating Engineering Society on September 26, 1961. Covering two years of research, this report emphasizes the importance of increasing task contrast by reducing reflected glare and the effect of this action on visual efficiency. It also includes a recommended new method of evaluating quantitatively the effectiveness of lighting for visual tasks, taking into consideration the reflected glare on the task as well as the quantity of illumination required.

Dr. Blackwell's research also shows that, through the use of efficient multi-layer polarizing light panels, reflected glare can be reduced considerably. As a result of increasing task contrast by reducing this reflected glare through polarized light, the visual efficiency of light is greatly increased . . . in fact, an improvement of 100% over unpolarized light can be expected in most practical room applications when the same lighting equipment layout is used.

\*Professor and Director, Institute for Research in Vision, The Ohio State University, Columbus, Ohio.

\*\*"Development and Use of Quantitative Method for Specification of Interior Illumination Levels on the Basis of Performance Data," published in the June, 1959 issue of Illuminating Engineering, pages 317-353.

\*\*\*"A General Quantitative Method for Evaluating the Visual Significance of Reflected Glare, Utilizing Visual Performance Data."

(\*) Trade Mark of PolRized Panel Corporation.

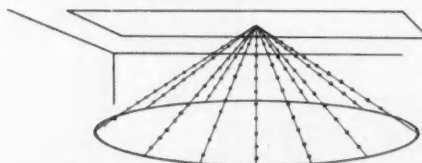
## THE PRODUCT

No one invented polarization and no one owns it! Polarization has been known for hundreds of years but it was only forty years ago that a practical, commercial use was discovered. This of course refers to the absorption-type, linear polarizing materials commonly used today for sunglasses, camera filters, 3-Dimensional projections, etc. However, these polarizing materials are not efficient transmitters of light since they absorb a high percentage of visible light.

In more recent years, the concept of polarizing light at the source by means of multi-layer polarizers was developed. These PolRized panels as now used in Sylvania lighting equipment increase task contrast by the reduction of reflected glare thus improving visibility and visual acuity compared to tasks viewed by unpolarized illumination.

Multi-layer constructed PolRized panels plane-polarize the light with a high transmission and produce a radial light distribution or cone polarization.

Sylvania fixtures using PolRized Panels transmit multiple reflections and refractions of light. This process is known as Reflux Polarization. The additive effect of the transmitted light provides a practical and efficient shielding medium for direct-distribution type luminaires.



The sketch illustrates how each pinpoint of light is polarized in every direction around the fixture. This Radial Distribution or Cone Polarization is emitted from each point on the surface of the PolRized Panel.

The radial distribution from Sylvania fixtures with PolRized lighting panels is of real significance in modern lighting practice since we recognize that visual tasks are performed in practically all directions and at varying angles to the light source. With the flexibility of modular construction, proper overall lighting is more desirable and practical than ever.



Over two years of objective scientific research at Ohio State University's Institute for Research in Vision proves that Reflected Glare is much more important for visual effectiveness than previously believed . . . that Multi-Layer PolRized(\*) lighting panels increase task contrast by reducing Reflected Glare substantially to make illumination better to see and work by.

# FIXTURES PANELS, REDUCE REFLECTED GLARE... EFFECTIVENESS 100%!

## WHAT THIS MEANS TO YOU . . . AND TO THE LIGHTING OF THE FUTURE

Blackwell's findings and the development of PolRized Panels represent together a significant breakthrough in the field of lighting. No longer will high footcandle levels be the only measured criterion of good lighting. Reflected glare and its effect on task contrast and visual acuity must be considered when evaluating and designing lighting requirements.

This research proves that polarization of the light source always improves vision. It makes seeing easier by eliminating "veiling glare." Obviously this improvement in seeing conditions means more comfortable and practical lighting and should result in higher working efficiency and accuracy. Visual mistakes and eye fatigue should both be reduced considerably.

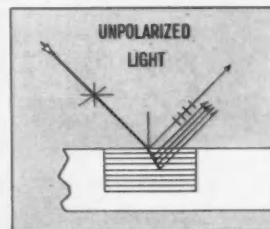
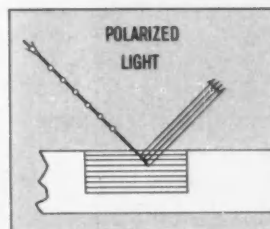
The studies show further that polarization enhances colors as well as improving vision . . . and that the benefits of polarization are realized more fully when used in a medium to large area and where the directions and angles of the seeing tasks vary. Thus, PolRized illumination is especially beneficial to general offices, schools, stores, banks and other commercial applications.

With the development of PolRized Lighting Panels, higher foot-candle levels for precision tasks can now be obtained with direct lighting without the corresponding increase in reflected glare.

Because of the significance of this research, Sylvania will make available immediately PolRized Panels for its direct distribution

fixtures and its overall luminous "Sylva-Cell" ceiling system.

Make certain you get full information on these products for all of your future lighting projects.



Sketches show how polarized light enhances colors by eliminating surface reflectance of the light source. This reflectance dilutes true color of substances.

Use this coupon to obtain more complete data on Sylvania fixtures with PolRized lighting panels.

LIGHTING FIXTURES BY

# SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS



Sylvania Lighting Products, Dept. E  
One 48th Street, Wheeling, W. Va.

- ( ) Send more information on Sylvania Fixtures with PolRized Panels  
( ) Have Sylvania Representative call on me to discuss PolRized Panels

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_


ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

WORLD'S MOST WIDELY USED  
ELECTRICAL TEST INSTRUMENTS

# AMPROBE®

THE ONLY LINE THAT COVERS ALL YOUR TESTING NEEDS



The original pocket size  
snap-around volt-ammeter-ohmmeter

**AMPROBE RS-3**

3 current ranges, 3 voltage ranges. Ohmmeter specially designed for the maintenance field. Rotary scale for faster reading and greater accuracy. Pointer-Lock "freezes" pointer at reading. Advanced printed circuitry laughs at rough handling. Advanced movement design—new internal core magnet with self-shielding characteristics. By itself, the Amprobe RS-3 handles 99% of your test needs. With the Amprobe Deca-Tran and Amprobe Energizer it covers EVERY testing situation.

Only \$52.50



## AMPROBE RS-1

The economy snap-around volt-ammeter with many features of the great RS-3 including rotary scale, pointer lock, printed circuit, and advanced movement design. 4 current ranges. 2 voltage ranges.

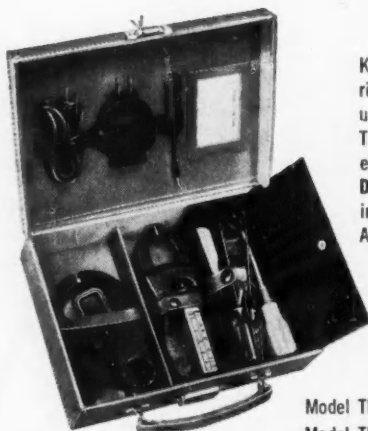
Only \$39.85



## AMPROBE JR.

The advanced voltage tester that gives you current, too. Available in seven models, ranging from 10 amps to 100 amps in either 125/250 or 150/600 volts. Choose the model that fits your job.

Only \$19.85



## AMPROBE TEST-MASTER KIT

Keep all your electrical-test tools right at hand with this rugged, genuine cowhide leather carrying case. The Amprobe Test-Master Kit contains either the RS-3 or RS-1, the Amprobe Deca-Tran (extends amperage readings 10x; as high as 1200 amps), the Amprobe Energizer (multiplies sensitivity of any Amprobe 10x for readings on small appliances and fractional h.p. motors), and a separate covered section to hold your small hand tools within easy reach.

Model TM-33 (with the RS-3): Only \$84.50

Model TM-11 (with the RS-1): Only \$71.75

AMPROBE INSTRUMENT CORP. LYNBROOK, N. Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND VOLT-AMMETERS.

# WIREMOLD® ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE  
TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

63rd YEAR

JANUARY 1962

RACEWAYS IN YALE LAB ..... FIRST PAGE

CODE COMMENTS ..... FIRST PAGE

EDITORIAL ..... SECOND PAGE

PRODUCT OF THE MONTH ..... SECOND PAGE

QUIZ CORNER ..... SECOND PAGE

COUPON FOR FREE ITEMS ..... SECOND PAGE

PERSONNEL AT MEETINGS ..... FOURTH PAGE

ENGINEERED SPECIALS ..... FOURTH PAGE

PRACTICAL TIPS ..... FOURTH PAGE

## Surface Systems Chosen For Yale Engineering Lab

Plugmold 3000 used throughout to bring 10 wiring  
services to classrooms and laboratories

The modern university electrical engineering laboratory must be built with two major purposes in mind:

1. the ability of laboratories to handle the complicated equipment required by such new fields as electronics, computers, ultra-high frequencies, servomechanisms, and magnetics; and

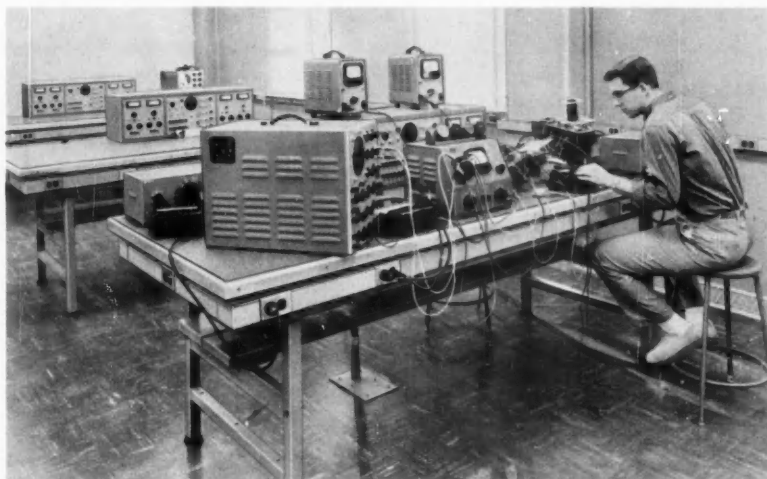
2. the provision for rapid changeover to accommodate changes in the future.

One of the most successful examples of the melding of these two

objectives is the new wing of the Dunham Laboratory of Electrical Engineering at Yale University.

As a result of investigation by the faculty, specifying engineers and the electrical contractor, it was decided to use Plugmold® 3000 throughout the 5-story addition. Among the advantages gained by this decision were appearance, the ability of the surface system to accept a number of different wiring services, and economy in purchasing and installing.

*continued on third page*



CONVENIENTLY located receptacles permit student to plug in delicate instruments re-

quired in the communications laboratory. Plugmold was used throughout the wing.

*Advertisement*

### Code Comments

#### Multi-Outlet Assemblies

**Q.** Are multi-outlet assemblies recognized by the Code?

**A.** Yes. They are defined in Article 100 as "A type of surface or flush raceway designed to hold conductors and attachment plug receptacles, assembled in the field or at the factory."

#### Highest Voltage

**Q.** What is the highest voltage that can be carried in Wiremold?

**A.** 600 volts is permissible in accordance with Article 352, Section 352-2 and Article 300, Section 300-2. This latter section states in part: "Wiring methods specified in Chapter 3 may be used for voltages not exceeding 600 . . ."

#### Conductors of Different Systems

**Q.** Can light and power conductors for AC and DC systems be installed in the same raceway?

**A.** Yes. Article 300, Section 300-3 (a) reads: "Conductors of light and power systems of 600 volts or less may occupy the same enclosure, without regard to whether the individual circuits are alternating-current or direct-current, only where all conductors are insulated for the maximum voltage of any conductor with the enclosure." However, Section 3(b) specifies that "Conductors of light and power systems of over 600 volts shall not occupy the same enclosure with conductors of light and power systems of 600 volts or less."

# WIREMOLD®

## Editorial

### Sell up in 1962

Among the many New Year resolutions made, one which should be kept by every electrical contractor is the promise to increase his sell-up efforts in 1962.

All indications point to this year as one with good business potential. If that potential is to be realized, then every person must make a personal effort to obtain the maximum available to him.

The contractor would do well to make up his mind that '62 will be the year in which he will become an expert salesman as well as an ace craftsman.

In addition to selling quantity, he should remember that selling quality is a good way to profits. Like selling Plugmold, for instance.

## Product of the Month

### Corner box designed for multiple uses

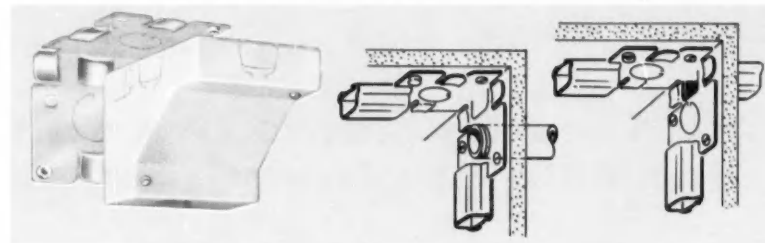
Designed for use as a multi-purpose unit with either Wiremold 500 or 700, the 5719 Corner Box is provided with plenty of splice room to facilitate making difficult connections.

Measuring  $2\frac{1}{2} \times 2\frac{3}{8} \times 2\frac{1}{2}$  inches, the box has a  $\frac{1}{2}$ -in. KO on each side of the base. For No. 500, the lower twistout is removed, for No. 700

both twistouts are broken out.

The fitting may be used for passing through a wall with either raceway or conduit. Other uses include flat elbow, twisted elbow, cross, tee, or twisted tee.

The 5719 is one of a complete line of standard Wiremold fittings available from your electrical distributor.



## Quiz Corner

Questions for this department are taken from inquiries received from the field. Your questions are welcome; indeed, they are necessary if this department is to serve you with worthwhile information. Address:

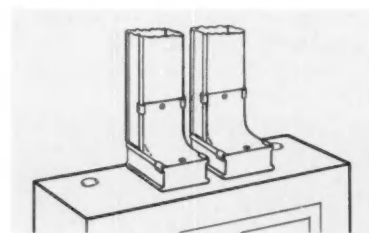
Quiz Corner  
The Wiremold Company  
Hartford 10, Conn.

**Q.** I have a lot of those round type duplex receptacles installed on the floor of an office job and have been trying to get replacement receptacles for them. Can you get them for me? Also, how about one of the new grounding type, with the U ground? Can I get these receptacles that will replace the regular parallel blade type that you used to use in the round box?

**A.** Yes to both questions. Specify "Receptacle only for 1543 (or 1543G if a grounding outlet is wanted) round box".

**Q.** I have a rewiring job where I am planning to use Wiremold 3000 direct from the panel box. What connector do I use?

**A.** No. 3086 Adjustable Offset Connector which has an adjustment from surface to center of bushing from 1-in. minimum to  $2\frac{1}{16}$ -in. maximum.



**Q.** Before installing, do I remove the base of Wiremold 500?

**A.** No. Wiremold series 200, 500, 700 and 1000 are one-piece raceways assembled at the plant. Base and capping do not come apart. Wires are pulled through as with conduit.

**Q.** In what forms is Plugmold available?

**A.** As 3-ft. and 6-ft. wired sections (1900 and 2000), as 5-ft. wired sections (2000), as Snapicoil® (1900, 2000 and 2200), and unwired for in-the-field wiring (1900, 2100 and 3000).

# WIREMOLD®

WIREMOLD ■ HARTFORD 10, CONN.

E2-1

Gentlemen: Please send free the checked items

NAME \_\_\_\_\_

☐ Electric Ideas, December 1961

COMPANY \_\_\_\_\_

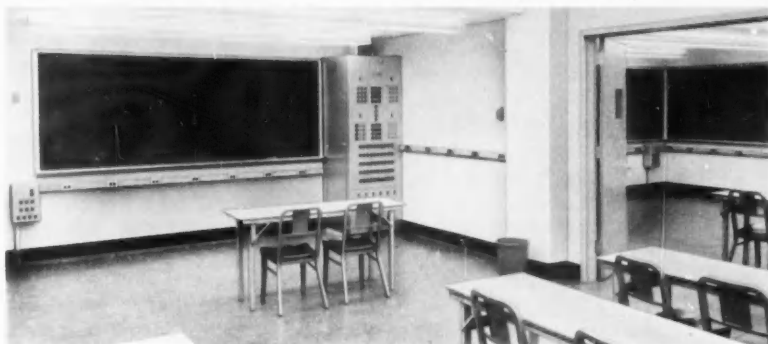
☐ Electric Ideas, November 1961

ADDRESS \_\_\_\_\_

☐ Wiring Guide (Catalog 22)

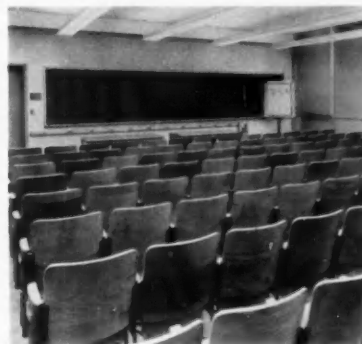


## Surface Systems Chosen For Yale Engineering Lab *continued from first page*



CLASSROOMS, too, are provided with plenty of conveniently located receptacles.

Use of multi-outlet assemblies throughout wing permits use of demonstration devices.

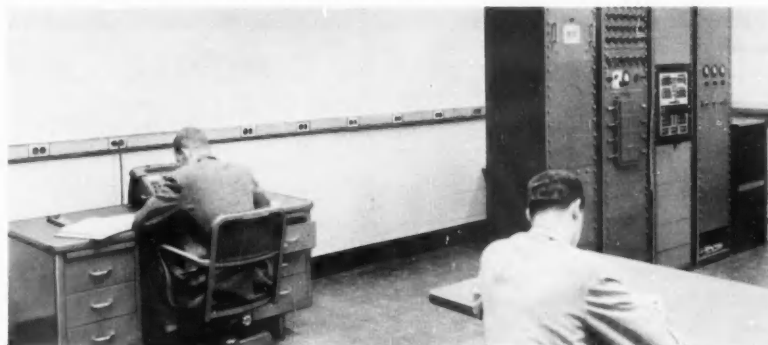


MAIN lecture hall is equipped with multi-outlet strips under chalk board and along back wall for audio-visual aids.



RECEPTACLES for tools and calibrating devices are a must in the magnetics laboratory workshop. Both benches and walls are equipped with grounding outlets.

tory workshop. Both benches and walls are equipped with grounding outlets.



NEW SCIENCE of computers requires extensive electrical equipment. This lab is

provided with sufficient outlets for present and future requirements.



TYPICAL of all lab benches in new wing. Plugmold 3000 enables students to use

modern electrical and electronic equipment wherever they need it.

Ten different types of services were required for lighting and powering the classrooms and laboratories. These were brought to faculty-designed switchboards through underfloor ducts. Receptacles were supplied through the 3000 system.

In some of the rooms different types of services and receptacles were installed in the same raceways. Typical raceways contained such services as: 2-wire grounding (A.S.A.), 110-125v.; 4-wire, 3-phase, 400 cycle, 120 v.; 2-wire, single phase, 400 cycles, 120 v.; and 3-phase, 60 cycle, 208 v.

Although this same pattern was not followed in all the rooms, use of the multi-outlet system permits additions or changes to any combination of voltages, frequencies, etc., which might be required by future demands.

In all cases, the 3000 which is installed on the walls was part of the main contract. The electrical engineering department staff also selected 3000 for all laboratory benches. Here, too, they had the problem of providing various frequencies and voltages.

The wing was designed by Douglas Orr Associates with Hubbard, Lawless & Blakeley as consulting engineers. M. B. Foster Electric Company, New Haven, were the electrical contractors.

After the building was completed, one of the professors was asked if he hadn't overdone the number of outlets. He answered: "Wait a little while and they'll agree I haven't."

**WIREMOLD®**

# Engineered Specials

Special strip with retractile cord developed for portable benches

## PROBLEM:

To provide a multi-outlet unit for a portable work bench.

## SOLUTION:

A special unit was devised consisting of a 30-in. section of Plugmold 2100 with three grounding receptacles. The unit is furnished with a 3-wire retractile power cord, positively grounded to the raceway.

## DISCUSSION:

To provide maximum flexibility at a government facility, it was de-

cided to use portable work benches that could be wheeled where needed. To avoid long, dangling cords for each tool, it was desirable that each bench act, in a sense, as its own power supply.

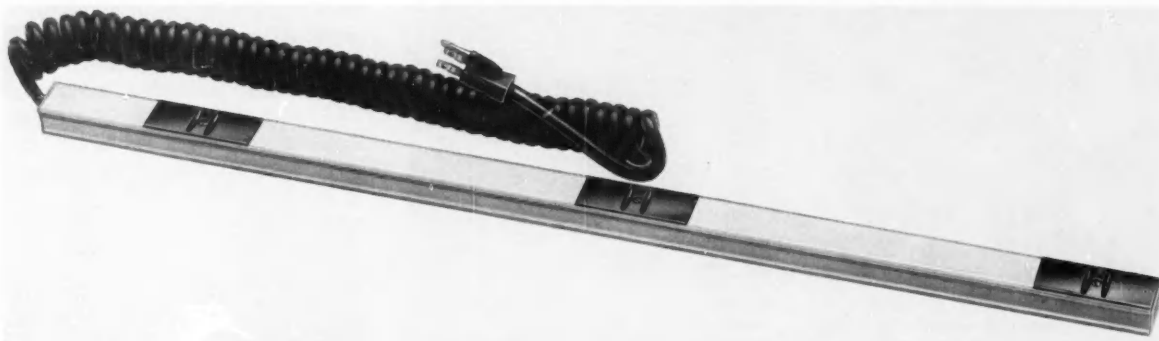
Working with the bench manufacturer, Wiremold engineers developed a special 30-in. strip of Plugmold 2100 with three grounding outlets on 12-in. centers. Grounding to the raceway was in accordance with Article 250, Section 250-59 of the National Electrical Code which states in part:

"Non-current-carrying metal parts

of portable equipment may be grounded in any one of the following ways:

"(a) By means of the metal enclosure of the conductors feeding such equipment, provided an approved plug is used, one fixed contacting member for the purpose of grounding the metal enclosure, and provided, further, that the metal enclosure is attached to the plug and to the equipment by connectors approved for that purpose."

Wiremold engineers happily accept the challenge of adapting products to meet in-field needs.



## Personnel at Meetings

The new year gets under way with a bang as Henning A. Thomsen, home office, Dick French, Philadelphia, and Tom Pugh, Baltimore, play host at Philadelphia's Convention Hall. Both Wiremold and Plugmold will be featured in the exhibit.



Henning A.  
Thomsen



Dick  
French



Tom  
Pugh

Show details are:

Plant Engineering and Maintenance  
Show, Convention Hall, Philadelphia, Pa., Jan. 22-25.

## Practical Tips

Forming internal bends with Wiremold 2000 and 2200

The method for forming internal bends in Wiremold 2000 and 2200 is simplified when the cover and base are preformed individually to the desired radius.

If a pre-bending fixture is not available, the proper arc may be obtained by sitting on the floor and with the feet against the raceway, incurvating the Wiremold. This technique can be used to bend 2000 to arcs of 5 or more feet and 2200 to arcs greater than 6 feet.

For curves of less than a 6-ft. radius, the raceway base and cover should be bent separately. The two parts may then be snapped together with little effort.

Engineers caution that internal bends formed on the job should be made with care.

External bends were discussed in December *Electric Ideas*, where it was noted that the minimum practical radius to which 2000 and 2200 can be bent is three feet for both external and internal bends.



**WIREMOLD®**  
HARTFORD 10, CONNECTICUT  
In Canada: Conduits National Co., Ltd.  
Toronto 2, Ontario

All WIREMOLD products are sold  
through electrical distributors — your  
best source for all electrical products.

Advertisement

## PULL OUT THE ATTACHED INQUIRY CARD RIGHT NOW

It will bring you information  
about the new reference  
tool from McGraw-Hill that  
keeps you abreast of today's  
exploding technology.  
Mail card today for free  
color brochure.



FIRST CLASS  
permit no. 26  
new york, n. y.



**BUSINESS REPLY MAIL**

No postage stamp required if mailed in the United States

postage will be paid by

**McGRAW-HILL BOOK COMPANY**  
331 WEST 41ST STREET  
NEW YORK 36, N. Y.

**McGraw-Hill Book Company**

331 West 41 Street, New York 36, N. Y.

Please send me your interesting color brochure describing McGraw-Hill's new method for keeping abreast of the explosive pace of current scientific and technological development. I understand there is no cost or obligation.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_

County \_\_\_\_\_ State \_\_\_\_\_

Occupation \_\_\_\_\_

ELECTRICAL CONSTRUCTION 62-1


"A first class tool without substitute."

— Scientific American

"Makes obsolete all other existing means of ready reference."

— The Engineer

The new  
McGraw-Hill Encyclopedia of  
**SCIENCE AND  
TECHNOLOGY**

MAIL THIS CARD NOW  
FOR A FREE COLOR  
 **BROCHURE**  
NO STAMP REQUIRED



*a comprehensive guide to current  
information on every branch of  
Science and Technology*

*... a practical new way to bridge the gap between your  
specialty and other fields into which your work leads you*

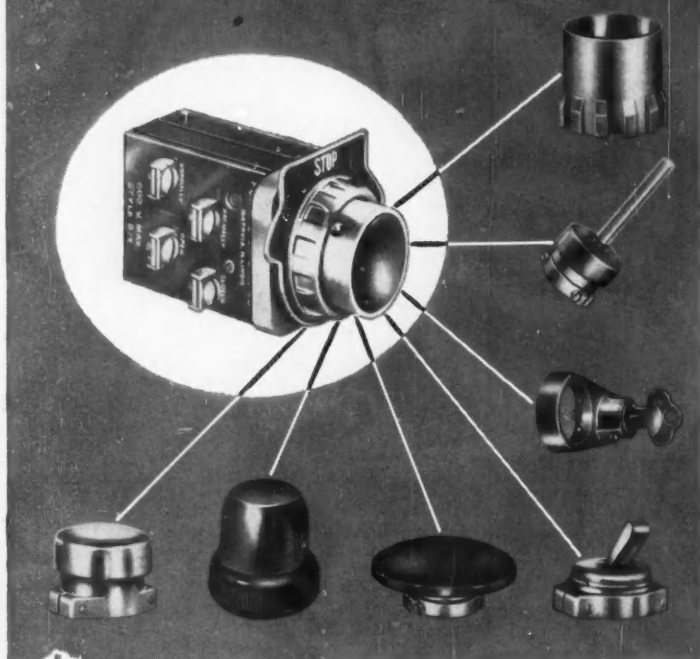


New from  
**McGRAW-  
HILL**



**If you find yourself among the  
growing number of science and  
engineering specialists unable  
to keep up with the explosive  
pace of developments today, you  
will see a valuable solution at  
the top of this page.**

# GREATER VERSATILITY WITH FURNAS OIL TIGHT PUSH BUTTONS

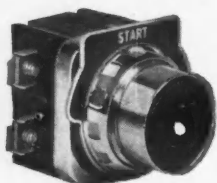


## ONE STANDARD OPERATOR FOR ALL ACCESSORIES

Add key locks, mushroom heads, levers, guards or other accessories to your push button station without removing, modifying, or ordering special operators. Simply attach the required accessory to a standard operator. Simplified design, ease of installation, interchangeability and finest materials assure your satisfaction. Furnas oil tight push buttons are available from single units through complete control stations, in eight colors.

# NEW

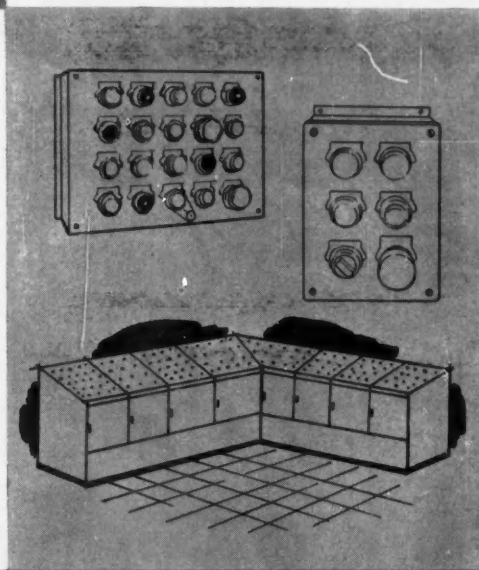
## FURNAS SHALLOW CONTACT BLOCK



- Save 50% space behind panel
- Increased flexibility in circuitry

This new shallow contact block is designed primarily for applications with limited depth behind panel and for greater flexibility in circuitry. Mounting screws have internally tapped heads for assembling in tandem.

Write today for Bulletin 50-B1—  
1067 McKee Street, Batavia, Illinois



# FURNAS ELECTRIC COMPANY

## BATAVIA, ILLINOIS

Sales Representatives in all Principal Cities



A114

## "Circloc" Interlocked Armored Power Cable NOW AVAILABLE IN DIAMETERS TO 4 INCHES

With our newest armored cable machine in full production, Circle customers can now get high quality Circloc interlocked armored power cable in diameters up to 4 inches—the most complete range of sizes available anywhere. This recent addition to its modern manufacturing facilities is Circle's answer to the growing need for larger diameter armored cable for power distribution.

Circloc cable can be supplied with 2, 3 and 4 conductors with varnished cambric or butyl rubber insulation and voltage ratings of 600 to 15,000 volts. Armor is available in interlocking galvanized steel, aluminum or bronze.

For your next power cable installation, be sure to specify compact, dependable Circloc interlocking armored cable.

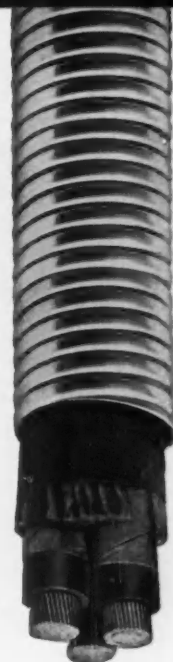


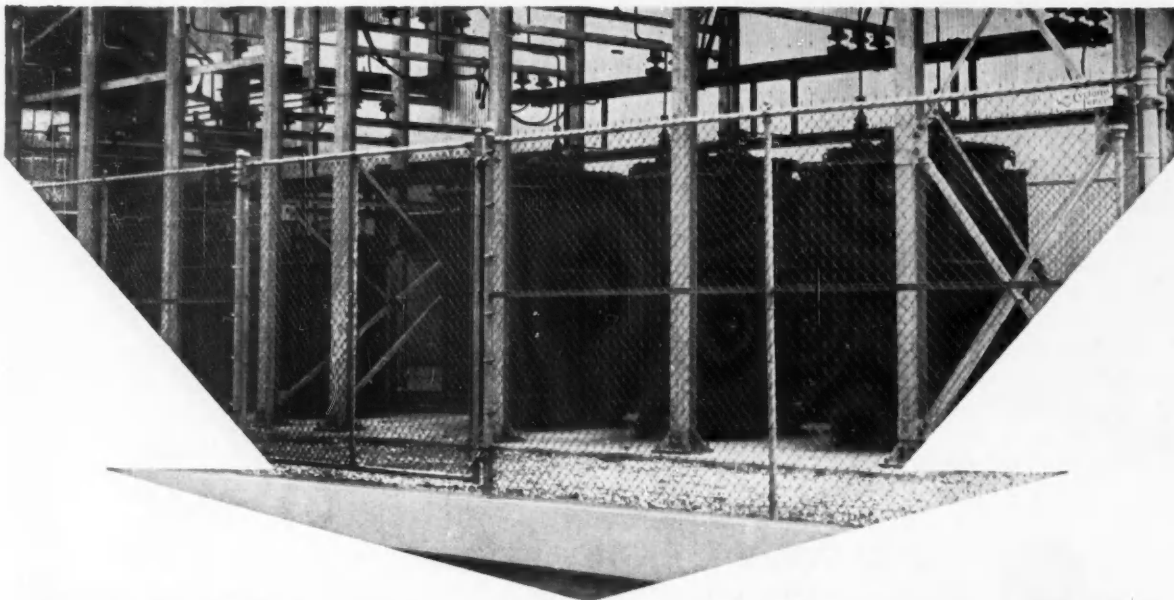
**CIRCLE WIRE & CABLE CORP.**

SUBSIDIARY OF CERRO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: In all principal cities.

Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT





## SIX WAGNER® TRANSFORMERS PROVIDE THE POWER

Here are six Wagner® transformers with a full-time job: providing all the power needed by a new electroplating line that produces tin plate for Granite City Steel Company.

Three of the six supply power to motor-generator sets which convert to DC for variable speed drives, and to plating generation equipment and other major equipment drives. They are all 1667 kva, single phase, 60 cycles, 7200/12470Y to 2400/4160Y volts transformers.

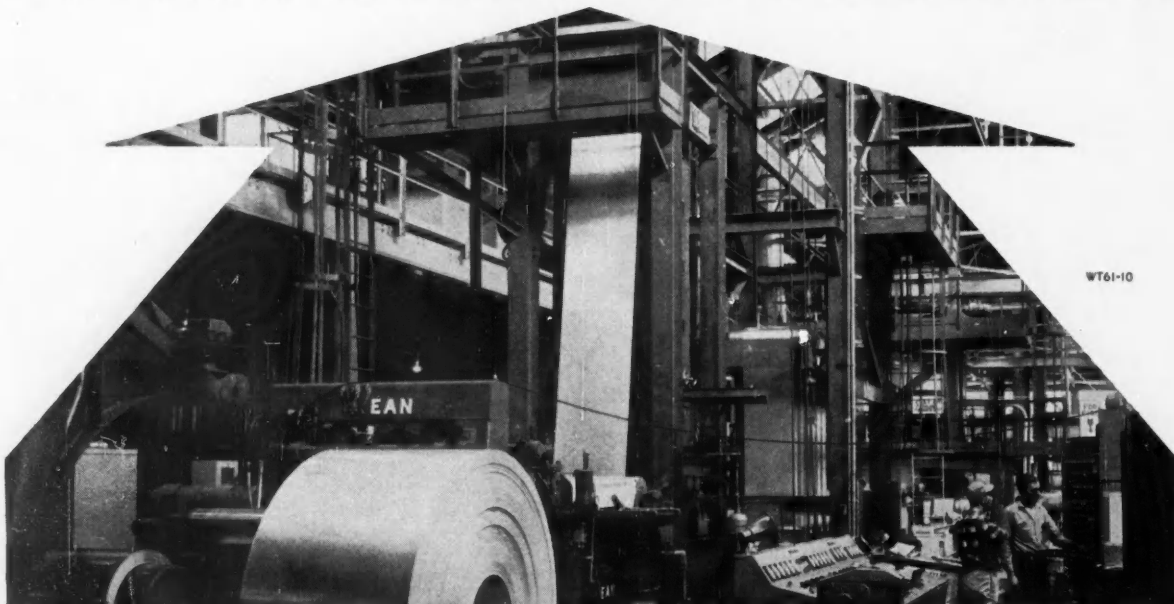
The second set of three transformers are all 500 kva, single phase, 60 cycles, 7200/12470Y to 240 x 480 volts. They supply power for auxiliary pumps, etc.

All six are of the latest design . . . have wound cores of cold-rolled oriented grain steel. Their performance stability is outstanding. They're built to be trouble-free . . . built to provide all the power the plating line needs. Wagner transformers are designed to provide all the power you need, too. Your Wagner Sales Engineer can show you how. Call him. Soon.

**Wagner Electric Corporation**

6413 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

## FOR GRANITE CITY STEEL'S NEW TIN PLATING LINE







©1962 VOLKSWAGEN OF AMERICA, INC.

## Ain't ours.

Volkswagen owners don't dig this stuff.  
Not when it's only this deep.

For one thing, our engine's in the rear.  
The weight sits on our drive wheels.

It's like putting concrete blocks in your  
trunk.

For another, most trucks only clear  
about 7 inches, but the VW clears 9½.  
Our bottom doesn't drag.

(In Chicago, Anderson Engineering's  
VWs get to electrical jobs while other  
trucks are waiting for the snow to stop.)

Even our air-cooling helps. The Volks-  
wagen engine does not use water. There's  
nothing to freeze up. You always go.

New VW owners sometimes feel un-  
easy about not buying anti-freeze. But  
there's no place to put it.

All this, however, doesn't mean our  
trucks never get stuck. A drift's a drift.

That's why we ask owners to use chains  
or snow tires. Just to be sure.

Would you like to know who has  
a Volkswagen Truck in your  
neighborhood? Wait until you  
get about 6 inches of snow. Then  
look to see who isn't shoveling.





# A Strong Arm...

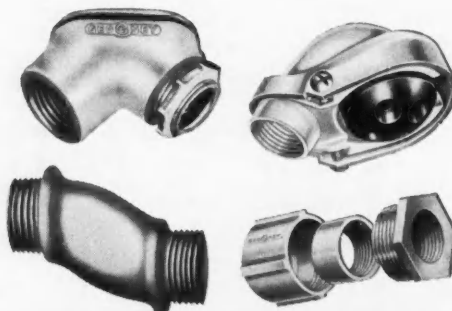
can fracture almost any fitting unless it's made of **malleable iron.**

Wrench it! Drop it! Pour on the pressure without restraint! A malleable iron fitting can take more punishment than any other fitting you can use. Why? Because malleable iron leads in every category of strength—tensile, impact, long term durability! No other material used for fittings today can do as well on the job as malleable iron. Experienced contractors and electricians know this. They know that "powder puff" fittings can't stand up under stress. They know too that Gedney has always been the leading name in malleable iron fittings. Protect your work and your reputation with Gedney. It costs no more!



**GEDNEY ELECTRIC COMPANY, INC.**

1270 Sixth Avenue, Radio City, New York 20, N. Y.  
Foundry, factory and shipping point: Terryville, Conn.



**"MALLEABLE IRON NEVER FAILS"**

Gedney malleable iron fittings can be supplied with a hot dip galvanized finish.

## ***Business in '62***

As the new year begins the market outlook for the goods and services of the electrical construction industry is exceptionally bright. Not in several years have we had so many favorable trends running at the same time. But before everyone sits back to enjoy the ride, it might be well to contemplate some problems that could block our ability to participate profitably from a market of potentially exceptional abundance.

This year will certainly set some new records in business volume for the electrical industry. But assured volume is not an unmixed blessing. When work is abundant, and the living looks easy, those who might be concerned with profit ratios are readily quieted by rising sales curves. But profit ratio, not volume, will be the vital measure of business in 1962.

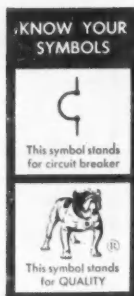
In industry trade channels, profit performance of the recent past has been less than satisfactory. In some areas of electrical manufacturing there is an excess of capacity and a cost-price squeeze. In a sensitively poised competitive market big orders are pursued fiercely, sometimes with havoc to the whole price and profit structure. Order in the market place must be restored, with common sense, courage and forbearance, so that sales produce not only a living wage for invested capital but a healthy margin for market development, research and progressive innovation.

Trading profit margins for sales volume has also had a depressing effect on distributor's net. Price cutting to capture large orders can add handsomely to individual sales statistics but, industry-wide, the margins given up in the process can never be recovered. A healthy, soundly-based, distribution arm is vital to the electrical industry but it cannot survive on brokerage fees regardless of the volume of business transacted.

Some contractors have engaged recently in a risky game of self-discounting or assuming costs for bidding substantially below current price information or quotations. They use the resulting lower "cost" as an advantage in competition. When the time comes to buy they expect to whipsaw suppliers into meeting their terms. The gamble is ultimately destructive because, win or lose, either the supplier or contractor, or both, must give up legitimate and essential profits to complete the deal.

Business in '62 should be outstanding in market opportunity. The climate should be excellent for a powerful all-industry drive to new levels of proud performance, of sound management and of creative industry development in all branches. But it will take a re-dedication to sound business policies and an enlightened awareness of the essential roles of profit and value, for ourselves, for those who serve us and for those we serve.

*Wm. T. Stuart*



## Bulldog Pushmatic panels

# Give maximum "on-the-job" flexibility

Look at all the residential circuit combinations you can wire  
with the PL12 Pushmatic Electri-Center!



- 6-circuit electric heat (220-volt)
- 24-circuit residential lighting panel
- 100-amp main and 20
- 100-amp main, range and 16
- 100-amp main, range, dryer and 12
- 100-amp main, range, dryer, water heater and 8

See our "Pushmatic Pocket Guide" \* for other panel and circuit combinations.

With all Bulldog Electri-Center® panels, you get exceptional residential circuit flexibility. The standard Single Pushmatic® circuit breaker puts a 110-volt lighting circuit in a single panel space . . . the Duplex puts two in a single space . . . and 2-pole Pushmatics, even 100-amp breakers, take but two

spaces. Result—Pushmatic breakers and Electri-Center panels answer all your residential circuit requirements . . . *with no callbacks.*

*\*Send for a copy of the "Pushmatic Pocket Guide." It's free!*



Bulldog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayton Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N. Y.



**I-T-E CIRCUIT BREAKER COMPANY**  
BULLDOG ELECTRIC PRODUCTS DIVISION



# Outlook for 1962

Prospects are excellent for a record construction year with gains of 7% or more expected in electrical construction and modernization activity.

**A** RECORD \$60 billion volume for construction in 1962 as forecast by the Department of Commerce represents an increase of about 5% over 1961. Against this background, *Electrical Construction and Maintenance* predicts gains in dollar volume of electrical work of about 7% in 1962 reflecting increased physical volume, higher costs and continued advance in utilization standards.

Electrical work in 1962 is estimated at a record 5,741 million, up 362 million from 1961. The forecast makes no allowance for fallout shelter programs or changes in the

defense projects. The estimates are based conservatively upon current trends at the year end with good prospects that advances in some categories may be more vigorous than present signs would indicate.

The electrical industry is particularly favored by strong growth potential in several market sectors. Automatic processing and materials handling in industry call for electrical systems of higher capacity and greater complexity in addition to more sophisticated apparatus. Lighting levels in both industrial and commercial applications are rapidly moving up through 100

fc and beyond, with large increases in associated systems and components. The prolific output of the electrical appliance industry is compelling residential electrical systems of greater capacity and accessibility. And the great market for electric heating is still relatively untouched in many parts of the country.

A large component of the 1962 market will be electrical modernization of existing buildings to bring them up to acceptable standards of electrical service and facilities. Traditionally this segment of the market has been estimated at about 25% of the total. There are, however, good prospects that this category may account for an increasing share of the market potential in the months ahead.

According to the Business and Defense Services Administration of the U. S. Department of Commerce, new construction expenditures may reach a record-breaking total of \$60 billion in 1962, 5% greater than the \$57 billion peak expected in 1961. A record is also expected in 1962 in the physical volume of work put in place.

The 1962 estimates are based on the assumption of a substantial increase in general economic activity. Because they include a tremendous volume of construction begun in 1961 which will be carried over into the new year, employment in the specialty trades (plasterers, electricians, etc.)—usually heavy in the later stages of the construction process—should be stimulated. Construction costs are expected to continue to increase moderately, and materials and labor should be ample.

Although the relative gains over 1961 for private and public construction are expected to be the same in 1962—5% in contrast to their disparate rates of anticipated

## Electrical Work

(Millions of Dollars)

	1960	1961 <sup>1</sup>	1962 <sup>2</sup>
<b>Private Funds</b>			
Residential .....	901	901	980
Industrial <sup>3</sup> .....	484	468	484
Commercial & Institutional .....	950	980	1,080
Utilities <sup>4</sup> .....	400	392	402
Farms .....	90	105	105
Other .....	8	12	12
<b>Total Private</b> .....	<b>2,833</b>	<b>2,858</b>	<b>3,063</b>
<b>Public Funds</b>			
Residential .....	25	29	33
Industrial .....	69	77	72
Educational .....	358	394	412
Institutional .....	198	209	225
Military .....	70	92	102
Highway & Conservation .....	280	292	304
Other .....	17	28	30
<b>Total Public</b> .....	<b>1,017</b>	<b>1,121</b>	<b>1,178</b>
<b>Total New Work</b> .....	<b>3,850</b>	<b>3,979</b>	<b>4,241</b>
<b>Modernization and Repair<sup>5</sup></b> .....	<b>1,200</b>	<b>1,400</b>	<b>1,500</b>
<b>Total</b> .....	<b>5,050</b>	<b>5,379</b>	<b>5,741</b>

### Notes:

1. 3rd quarter estimated.
2. Estimated.
3. Does not include motors, controls or electrical equipment which are a part of machines or manufacturing processes.
4. Does not include electrical apparatus used in generation and distribution, nor communication equipment.
5. Does not include replacement lamps.

gain in 1961, private construction will likely account for 2 of the 3 billion dollar anticipated total increase. Three-fourths of the 1962 gain in private construction is expected to be attributable to non-farm residential building expenditures—which reversed in trend and increased substantially late in 1961. However, these expenditures, which will probably amount to \$24 billion in 1962, will still be below the 1959 peak of almost \$25 billion.

Though private construction expenditures in 1961 may barely miss the 1959 record level of \$40.3 billion, their anticipated level in 1962 has significance beyond achieving a \$42.3 billion peak. Virtually every private construction category should either maintain previous high levels or increase moderately. Over-all gains in private construction may well be sustainable into 1963.

Public construction expenditures, which declined slightly in 1960 for the first time since World War II, are expected to resume their long-term trend in 1961, a record-breaking \$17-billion year being assured. An \$18-billion mark in 1962 is likely.

The housing starts outlook for 1962 reflects the growing influence of housing legislation enacted in 1961, as well as anticipated favorable money-market conditions and relatively low interest rates for residential mortgages. A total of 1,400,000 new private housing units and more than 55,000 public housing units is foreseen, compared to 1,300,000 private and 50,000 public units in 1961.

### **Private Construction**

The year 1962 could well be the second best housing year on record, whether measured in terms of dollars or new starts. Total starts should exceed those in 1961 by 100,000, mainly because of the low level of starts early in 1961. Anticipated 1962 expenditures for new housing units assume a fairly steady rate of seasonally adjusted starts throughout the year.

The same influences which spurred the upturn of new housing in recent months are likely to prevail throughout 1962. These are: the continued rising construction rate of rental-type housing despite relatively high vacancy rates; somewhat lower mortgage interest rates than in the past few years;

the shift of housing demand to multifamily types; the growing effect of urban renewal; and increased housing requirements of the elderly.

The increasing popularity of shell houses and the use of prefabricated components, both of which tend to reduce costs somewhat, may be important factors in determining both the type of houses and the cost levels at which they are produced in 1962. The influence of the liberal financing terms of FHA-insured mortgages on the terms of conventional types should be felt even more strongly in 1962. However, loan funds should be relatively abundant.

Because of changes in methods of measurement, the statistics for 1961 and 1962 residential additions and alterations are somewhat incomparable with those for 1960. Therefore, the estimated \$5.3 billion level for 1962 may somewhat understate the basic trend. The impact of the Housing Act of 1961, which liberalizes the financing of additions and alterations, has not yet been fully felt. This should occur in 1962. In 1963, the impact should be even greater.

The dominant influence on 1962's nonhousekeeping building expenditures is expected to be an unusually large carryover of unfinished work from 1961. The anticipated sharply reduced rate of increase from 27% in 1961 to 11% in 1962 does not presage a weakening of long-term influences. Highway construction is still sparking an unusually large volume of motel building, and private college dormitory construction continues to increase.

In 1962, the over-all rate of increase in private nonresidential building should be slightly lower than in 1961. However, in contrast to 1961, no single category in this group is expected to decline. Modest downtrends in industrial, religious, and social and recreational building should be halted. Small gains are expected in industrial and religious construction, but social and recreational is expected to continue at the 1961 rate. Other categories of nonresidential building are expected to increase, but at a somewhat lesser rate than in 1961.

Industrial construction is expected to total only \$2.8 billion in 1962, or a 2% increase over 1961, for a variety of reasons. First, manufacturing capacity is more than ample; current high industrial

output has not exceeded capacity. Second, emphasis on modernization investment to cut costs and increase productivity tends to favor outlays for new equipment rather than new plants. Third, modern plants require relatively less space for new capacity than did older plants. Finally, recent rapid cyclical changes have encouraged conservatism in capital spending.

Commercial construction, the pace of which in the last few years has been somewhat contracyclical to general economic activity, is expected to account for almost 40% of the dollar increase in nonresidential building in 1962. Though rising to \$4.8 billion, an alltime high, this category is expected to gain only modestly, 3%, compared to 12% in 1961.

### **Office Buildings**

A national office-building boom is quite evident, but expenditures are expected to increase only 4% in 1962 over 1961. Formerly confined mainly to New York City, it has spread to other metropolitan centers. At the same time, of course, the size of the buildings have tended to become considerably smaller. Despite substantial vacancy rates in some older commercial buildings, demand is strong for modern prestige office space.

The rate of increase in the construction of stores, restaurants, and garages—largely in the form of shopping centers—will also slow noticeably in 1962. The 12% increase expected in 1961 will probably yield to a mere 3% in 1962. Competitive conditions are now apparently causing a cautious approach by investors, especially as to long-term growth prospects of local retail and service businesses.

The upward trend in other private nonresidential buildings is expected to continue into 1962. The annual rate of gain will be about the same in 1961 and 1962, 6 and 5% respectively. Religious, educational, hospital and institutional, and social and recreational construction expenditures are expected to sustain or surpass peak expenditure levels. The expected 11% gain in 1962 in hospital and institutional construction should push spending to almost 50% beyond 1960 levels, reflecting the continued availability of Hill-Burton Federal-aid funds. On the other hand, social and recreational construction, which

# New Construction Put in Place in the United States 1960, 1961 and Outlook for 1962

Type of construction	Value (in millions)			Percent change	
	1960 <sup>1</sup>	1961 <sup>2</sup>	1962 <sup>3</sup>	1960-61	1961-62
<b>TOTAL NEW CONSTRUCTION</b>	<b>55,556</b>	<b>57,325</b>	<b>60,250</b>	<b>+ 3</b>	<b>+ 5</b>
<b>PRIVATE CONSTRUCTION, TOTAL</b>	<b>39,603</b>	<b>40,260</b>	<b>42,250</b>	<b>+ 2</b>	<b>+ 5</b>
Residential buildings (nonfarm)	22,546	22,550	24,000	+ 5	+ 6
New dwelling units	16,422	16,250	17,400	- 1	+ 7
Additions and alterations	5,199	5,125	5,300	- 1	+ 3
Nonhousekeeping	925	1,175	1,300	+27	+11
Nonresidential buildings (nonfarm)	10,168	10,740	11,125	+ 6	+ 4
Industrial	2,851	2,760	2,825	- 3	+ 2
Commercial	4,180	4,665	4,825	+12	+ 3
Office buildings and warehouses	2,121	2,365	2,450	+12	+ 4
Stores, restaurants and garages	2,059	2,300	2,375	+12	+ 3
Other nonresidential buildings	3,137	3,315	3,475	+ 6	+ 5
Religious	1,013	985	1,010	- 3	+ 3
Educational	566	590	625	+ 4	+ 6
Hospital and institutional	605	785	875	+30	+11
Social and recreational	707	690	690	- 2	0
Miscellaneous	246	265	275	+ 8	+ 4
Farm construction	1,285	1,500	1,500	+17	0
Public utilities	5,323	5,220	5,350	- 2	+ 2
Railroad	285	240	250	-16	+ 4
Telephone and telegraph	1,088	1,035	1,075	- 5	+ 4
Electric light and power	2,058	2,150 <sup>4</sup>	2,150	+ 4	0
Gas	1,767	1,650 <sup>4</sup>	1,750	- 7	+ 6
Other public utilities	125	145 <sup>4</sup>	125	+16	-14
All other private	281	250	275	-11	+10
<b>PUBLIC CONSTRUCTION, Total</b>	<b>15,953</b>	<b>17,065</b>	<b>18,000</b>	<b>+ 7</b>	<b>+ 5</b>
Residential buildings	716	835	950	+17	+14
Nonresidential buildings	4,792	5,200	5,450	+ 9	+ 5
Industrial	407	450	425	+11	- 6
Educational	2,818	3,100	3,250	+10	+ 5
Hospital and institutional	400	365	400	- 9	+10
Administrative and service	598	675	750	+13	+11
Other nonresidential buildings	569	610	625	+ 7	+ 2
Military facilities	1,386	1,375	1,375	- 1	0
Highways	5,464	5,700	6,100	+ 4	+ 7
Sewer and water systems	1,487	1,600	1,700	+ 8	+ 6
Sewer	882	925	1,025	+ 5	+11
Water	605	675	675	+12	0
Public service enterprises	649	610	600	- 6	- 2
Conservation and development	1,221	1,375	1,425	+13	+ 4
All other public	238	370	400	+55	+ 8

<sup>1</sup> Bureau of the Census statistics.

<sup>2</sup> Bureau of the Census statistics Jan.-Oct. except where otherwise indicated; BDSA estimates Nov. and Dec.

<sup>3</sup> BDSA estimates.

<sup>4</sup> Bureau of the Census estimates through October 1961 have been adjusted by BDSA to reflect recent but preliminary information.

<sup>5</sup> Change of less than one-half of 1 percent.

mounted between 1955 and 1960, when outlays tripled, seems to have lost its momentum. Nevertheless, a continued peak level of \$700 million is expected. Religious construction will likely maintain the billion-dollar rate first achieved in 1960 and just missed in 1961. It is chiefly influenced by the move of population to the suburbs. Private educational building will exceed the \$600 million mark in 1962 for the first time, colleges and parochial elementary schools both contributing substantially to the rise.

The effects of a declining number

of farms and of rising farm incomes tend to offset each other in influencing the continuation of the \$1.5-billion rate of expenditure in 1961. The farm construction category is still well below the peak of \$1.9 billion of a decade ago.

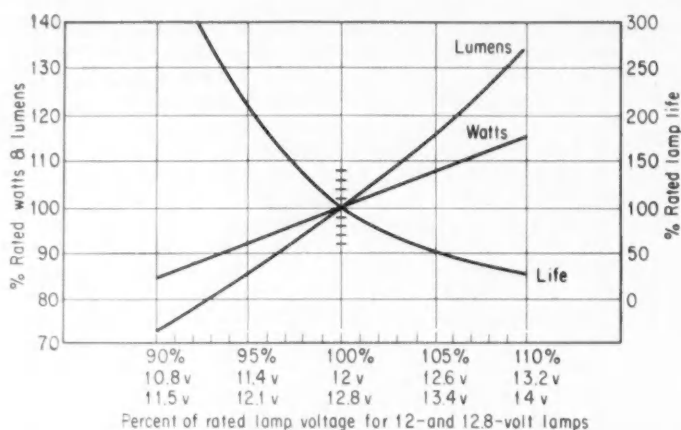
Public utilities expenditures in 1962 should not increase markedly. No change in volume is expected by electric light and power companies, and only small increases seem likely for telephone and railroad companies. The gas industry's spending plans for construction are marked by some deferment beyond

1962, particularly by pipeline companies.

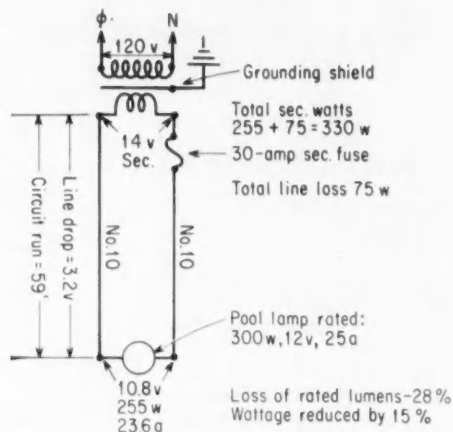
## Public Construction

Most of the nearly \$1-billion rise in public construction in 1962, which will result in a new high of \$18 billion, will be for State- and locally-owned facilities. Federal aid will be a decisive stimulating factor for the categories showing the most significant increases. For example, in contrast to the anticipated overall gain of 5% over 1961, residen-

(Continued on page 153)



**FIG. 1**—Chart illustrates what happens to lamp life, wattage and light output when 12- or 12.8-volt incandescent lamps are operated at voltages higher or lower than design ratings. Percentages at the bottom of chart provide equivalent voltages for each value. Notice how lumens drop sharply with a reduction of less than one volt below lamp ratings.



**FIG. 2**—Diagram shows the effect of excessive circuit lengths. The rated 12-volt 300-watt lamp produces only 255 watts when the voltage at the lamp is 10.8 volts. Lumen output losses are 28%. Shortening the run to 34 ft would remedy situation.

## Solving the Circuit Problems of 12-Volt Pool Lighting

This article describes the causes and effects of improper voltage supply to 12-volt lamps used with wet-niche swimming pool fixtures. Recommended circuit sizes and advancements in lamp and transformer designs are also discussed.

**S**AFETY is one thing. Performance is another. But to be acceptable both factors must be considered. Such is the case of the 12-volt lamp for underwater pool lighting where one volt makes a world of difference in lamp performance.

Other than being inherently safe, there is nothing unusual, electrically, about 12-volt wiring systems. Ohm's law and the allowable current-carrying capacities of NEC conductors still apply. A circuit having a given line resistance and given line current has the same I<sup>2</sup>R line losses and the same line voltage drop whether the supply voltage is 120 volts or 12 volts. However, these losses are more significant at the lower voltage because the loss percentages are about ten times greater.

As an example, assume that a 2-wire circuit has a line resistance of 0.04 ohms and carries a load of 25 amps. The line drop would be 1 volt

By J. H. Watt

( $0.04 \times 25$ ), and the line loss would be 25 watts ( $25^2 \times 0.04$ ). For a 120-volt supply the 1-volt drop would mean little, representing a percentage line drop of 0.83%, which is less than 1%. On the other hand, the 1-volt drop from a 12-volt supply represents a percentage line drop of 8.3%, which would sharply reduce the light output of an incandescent lamp rated at 12 volts.

Since transformers and circuit wire sizes must be selected on the basis of the lamp, the first step is to examine the characteristics, types and sizes of representative, 12-volt incandescent lamps currently used with underwater luminaires.

Surprisingly, a 12-volt lamp has greater efficiency (lumens per watt) than a 120-volt lamp of

equal wattage classification. Larger, more-rugged filaments will be found in the 12-volt lamp because of the higher current. And it follows that there is less proportionate gas loss with larger filaments. This accounts for the increase in lumens per watt.

Various sizes and types of lamps are available. Sizes range from 40 watts to 500 watts; and the basic types are PAR, R40 and G30. The R40 and G30 lamps are rated at 300 watts and are intended for use in enclosed housings with a gasketed lens assembly. PAR lamps are sealed-beam reflector lamps, similar to modern automobile headlights. In fact, low-voltage PAR lamps 150 watts or less are automotive types, and, in general have design ratings of 12.8 volts. For 300- and 500-watt lamps, the design ratings are 12 volts. In any event, it is best to verify lamp design voltages with the particular lamp manufacturer. Then once the volt-



Nominal Lamp Watts	Nominal Lamp Amps	Wire Size (TW Copper)	*Circuit Length One Way (ft)		**Line Loss (Watts)		Volts Drop Per Ft of Circuit (One Way)
			1 VD	2 VD	1 VD	2 VD	
(12.8v) 90	(12.8v) 7	18	10	20	7	14	0.1
		16	15	30	7	14	0.066
		14	27	54	7	14	0.037
(12v) 100	(12v) 8.3	16	13	26	8	16	0.077
		14	21	42	8	16	0.042
		12	36	72	8	16	0.028
(12v) 300	(12v) 25	10	17	34	24	48	0.059
		8	27	54	24	48	0.057
		6	47	94	24	48	0.021
(12v) 500	(12v) 42	6	26	52	41	82	0.038
		4	41	82	41	82	0.024
		2	71	142	41	82	0.014

\*Based on Formula:

$$\frac{2r \times L \times I}{CM} = VD \text{ or } L = \frac{CM \times VD}{2r \times I}$$

\*\*Based on Formula:

$$\frac{2r \times L \times I^2}{CM} = W$$

Where:  $r = 12$  for wire carrying 50 to 100% load

$r = 11$  for wire carrying less than 50% load

$L =$  one way length of circuit (ft)

$I =$  current in each wire

$CM =$  cross-sectional area of each wire in circular mils

$VD =$  line voltage drop

$W =$  line loss in watts

Wire Size	Circular Mils	NEC Carrying Capacity 60°C Wire
18	1624	7A
16	2583	10A
14	4107	15A
12	6530	20A
10	10,380	30A
8	16,510	40A
6	26,250	55A
4	41,740	70A
2	66,370	95A

FIG. 3—Table, formulas and wire data provide a quick method for calculating voltage drop, wattage line losses and circuit lengths for given wire sizes and lamps. The 1 VD values in the table can be used as multiples for computing circuit lengths and wattage line losses at 3 volts drop or more. However, the secondary voltage at the transformer must equal the sum of the rated lamp voltage and the voltage drop.

age rating is known, this becomes the target in the circuit design.

As shown in Fig. 1, voltages above or below the rated lamp voltage alter lamp performance. Undervoltage reduces total lumen output, lumens per watt, lamp wattage and amperage; and overvoltage increases these factors. Although overvoltage increases light output, the life of the lamp will be shortened. As a result, economics would generally preclude operation at overvoltage.

Examining the lamp-life curve in Fig. 1 could lead one to believe that operating a lamp at less than its voltage rating will be advantageous. However, this curve does not anticipate lamp breakage, which is likely to occur in submersible fixtures because of thermal or physical shock. Providing the proper voltage at the lamp far outweighs any consideration for using reduced voltage to gain expected longer life.

It has been common practice to

operate 12.8-volt, 90-watt PAR lamps at 12 volts, but more light output can be realized by providing as close to 12.8 volts at the lamp as possible.

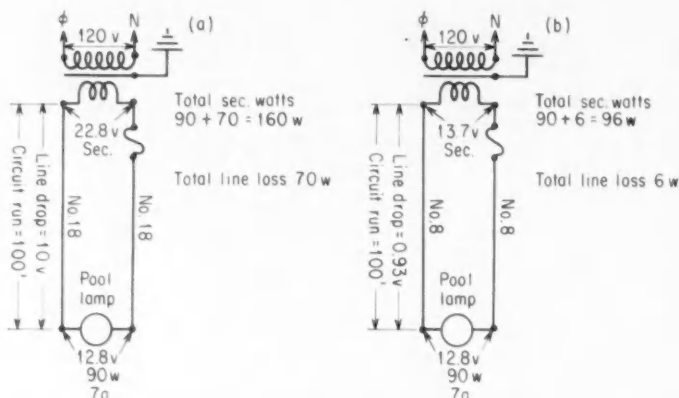
Fig. 2 shows what happens when a 12-volt, 300-watt lamp operates at 10.8 volts. The reduction of 1.2 volts below the 12-volt rating is equal to a 10% drop. As a result, the lamp watts are 255 instead of 300, thereby reducing the rated lumens by 28% and the rated wattage by 15%. The line loss is 75 watts, and added to the 255 lamp watts, give a total secondary wattage of 330 watts.

The table in Fig. 3 has been compiled to simplify the calculation of wire sizes for several common 12- and 12.8-volt lamps. It should be noted that a 12-volt, 100-watt lamp is listed in the table in anticipation of a PAR lamp at this rating, which will be designed specifically for underwater lighting, with wide flooding characteristics of 60° hori-

zontal and 40° vertical spread. In figuring circuit lengths with respect to voltage drop and circular mils, the formula shown in the table was selected on the basis of copper conductors. For use as a guide, the table gives nominal wire sizes for each lamp size and the maximum one-way circuit length for one and two volts drop. Also given are wattage line losses. The last column provides the volts drop per foot of circuit for three wire sizes in each lamp rating. Current-carrying capacities of No. 18 and No. 16 conductors are based on special UF type cable containing stranded conductors in these sizes.

As the table denotes, maximum circuit lengths are rather short to hold the line drop to one or two volts. To provide the proper voltage at the lamp (12 or 12.8 volts) the voltage at the transformer must equal the sum of the required lamp voltage and the line voltage drop. For a 12-volt lamp, the voltage at the transformer would have to be 14 for a 2VD and 13 for a 1VD. As far as present UL-listed pool transformers are concerned, 14 volts would be about the highest level attainable. This is due to a UL requirement that the open-circuit, secondary voltage of such transformers cannot exceed 15 volts. Under load conditions, this value would generally be reduced to 14 volts, leaving a maximum line drop of 2 volts to a 12-volt lamp. The 15-OCV limitation specified by UL may possibly be raised if a special NEC technical subcommittee recommends a higher figure. According to one of the subcommittee members, a 24-volt maximum OCV is under consideration. And if this or some other value is adopted in the NEC, a UL official has indicated that they would revise their standard accordingly.

Regardless of the maximum secondary voltage, which will be established in the future, the table in Fig. 3 is flexible enough to cover any desired voltage drop between the transformer and lamp. Because voltage drop is directly proportional to the length of a given conductor at a given current, the circuit length for 1VD can be used as a multiple. Taking a figure from the table, the one-way circuit distance for a No. 10 conductor feeding a 300-watt, 12-volt lamp is 17 ft for 1VD. At 2VD the length is 34 ft. At 3VD the length would be 51 ft (17 at 1VD times three). And



**FIG. 4**—There are two methods by which proper voltage can be delivered to a lamp over a long circuit run. In drawing (a), small circuit conductors require 22.8 volts at the transformer to permit a 10-volt line drop. Notice that the line loss is 70 watts. The transformer must be sized to handle 160 watts. Drawing (b) shows the use of larger circuit conductors, which hold the line drop to less than one volt. Total secondary load is only 96 watts due to low line loss. Only 13.7 volts are required at transformer.

as the voltage drop increases, the secondary voltage at the transformer must be raised in proportion. However, it should be noticed that wattage line losses increase in multiples also, as line drop increases. Such a condition could overload the transformer, which in turn could cause reduced voltage. Thus it is important to realize that the total secondary wattage is the sum of the wattage line losses and the lamp wattage. Where wattage line losses are high, a larger transformer capacity may be required in order to maintain the proper secondary voltage. It has not been uncommon to find that the cause of undervoltage at the lamp was due to the transformer being overloaded or of poor design.

In Fig. 4, two methods are shown which can provide the proper voltage at the lamp. For a 90-watt, 12.8-volt lamp, there is a 10-volt drop between the transformer and lamp (Fig. 4a). However, the line loss is 70 watts, which, added to the lamp watts, provide a total secondary load of 160 watts. For the same lamp, Fig. 4b shows the use of larger circuit conductors with a voltage drop of less than 1 volt. With a line loss of only 6 watts, the total secondary load is 90 plus 6 or 96 watts. By way of comparison, the former permits smaller circuit conductors but requires more transformer capacity. The latter requires larger circuit conductors but less transformer capacity; and in addition, the operating costs would be much lower where this is a consideration, as in the case of a large

commercial pool with a number of lamps involved. The circuit shown in Fig. 4a could not use a UL-listed transformer, but a number of local ordinances approve transformers with higher secondary voltages than recognized by UL.

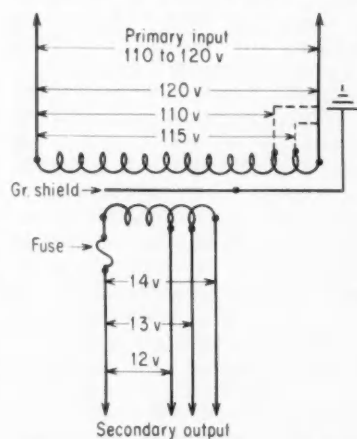
Some pool transformers have no provision for making adjustments for the secondary voltage output. As such, the secondary voltage is at a fixed level. The transformers shown in Fig. 4 fall in this category. Thus a specified line voltage drop must be attained through selection of specific wire sizes and lengths to provide rated voltage at the pool lamp. This leaves little latitude to fit the varying needs of

each pool installation. To overcome this limitation, UL-listed transformers are available with secondary taps providing 12, 13 or 14 volts under load conditions. With such transformers it is possible to use the correct tap for a line drop of one or two volts. In this way, the secondary voltage can be adjusted according to the distance between the transformer and pool light after computing the circuit wire size for a given drop.

Another cause of undervoltage at the pool light concerns the primary voltage input. Assuming that the secondary circuit wiring to the lamp is sized for a 2-volt drop, the secondary voltage at the transformer would have to be 14 volts to provide 12 volts at the lamp. If the primary input rating is 120 volts to provide a rated secondary voltage of 14 volts, the secondary voltage would be reduced to less than 13 volts should be primary supply be 110 volts. In turn, the voltage at the lamp would be about 11 volts.

To allow maximum flexibility, transformers with primary and secondary taps (as shown in Fig. 5) will be available in the near future. This will permit complete voltage adjustment to suit the occasion. Transformers of this type will be available for single or multiple lamp installations, ranging in sizes up to 1000 va, the limit for Class 1 low-voltage power circuits. A 1000-va transformer offers a practical solution to serving three 300-watt pool lights or several small units.

Experience with 12-volt pool lighting to date indicates that the best way to avoid large circuit conductors, excessive line losses or poor voltage supply at the lamp is to place the transformer as close to the lamp as possible. Presently under consideration by the NEC subcommittee on swimming pools is a rule that would place the transformer at least four feet horizontally from the edge of the pool and at least 12 inches above the adjacent deck surface. If adopted, the latter would rule out the possibility of a special flush deck box/transformer currently being considered by equipment designers. As a result, the code committee should allow sufficient latitude in their proposals for the development of such specially designed equipment. This could be the best solution to the circuit problems of 12-volt pool lighting.



**FIG. 5**—A transformer such as shown in the schematic will be available in the near future. With primary and secondary taps, accurate adjustments can be made to suit the requirements of any installation. A similar transformer, listed by UL, is presently available with secondary taps only.

# Planning Cuts Man-Hour Unit Costs

High labor costs emphasize importance of quality tools and installation equipment, method simplification and, above all, experienced job bosses who can conserve effort by advocating better than specified electrical components incorporating installation-aiding plus-values. Practical examples illustrate these possibilities.

By Stan Alexander, Field Superintendent, Fischbach & Moore, Inc.

**R**ECENT specifications called for installation of approximately a thousand lighting fixtures listing at \$12 each. We, however, requested permission to substitute, "for the same price," a costlier unit listing at \$13.50. Owners and architects were puzzled but pleased, and permission was graciously granted.

Our proposal, however, was not altruistic. Rather, it was based on experience which indicated that the specified \$12 item would require one man-hour to install, whereas the "more expensive" fixture could be obtained factory-assembled, completely pre-wired and capable of being installed in 25 minutes. This substitution of a better product boosted our basic fixture costs about \$1500, but the costlier item also resulted in a time saving of over 500 hours, making an appreciable net contribution to the over-all profit margin.

This experience illustrates the point that, when quantities of electrical components are large, even small net per-unit combination material-labor savings can add up to acceptable totals. It also emphasizes the point that quality products generally have plus-values which can justify the higher price tags. Such values can contribute to longer life, more efficient operation, greater output with reduced power consumption, easier maintenance or (as was true in the example just presented) faster installation rou-

tines resulting in the conservation of time, energy and dollars. These benefits stress the importance of product-knowledge plus knowledge compiled by study, comparison and field-tested experience.

## Packaged Assemblies

We also have found that standard products generally can be modified economically in the factory to incorporate desired variations, and that items frequently can be combined with other components, conduit and wiring to form "package" combinations. These readily handled time-saving combination units are then assembled on jobsites by production-line or mass-assembly methods. On large projects where many routines are repetitive, such product modifications and packaged assemblies can simplify the work by making products and structural features of a building more "compatible"; or by reducing "high time" of electricians spent on ladders or scaffolds; or by minimizing subsequent materials-handling sequences. These resultant time savings may be small when considered separately, although, when multiplied many times, the over-all savings can become critical in the final profit picture.

Many savings of effort can be planned before jobs get underway, provided an experienced team consisting of an estimator and job boss can spot such opportunities

during their preliminary studies of plans and specifications. Such savings can relate to possible changes in routing, mounting or use of specific products; in equating specified work-units to tested assembly or installation methods; in planning to use special equipment; or in proposing the substitution of products having favorable installation plus-values such as those previously noted.

In the recent past we have obtained both material and labor savings by changing directions of wiring from lengthwise to crosswise in buildings, thereby bypassing numerous physical obstructions such as beams, ducts and columns. In these instances we were able to spot fixtures in all desired locations, although we could route our circuits along corridors instead of going through walls, reaching our objectives with less time and effort involved.

Study of plans can also suggest which runs should go overhead and which ones should be installed underground. They can also suggest variations in branch-circuit routing so as to obtain structural support for conduit not otherwise provided for.

## Sleeves Preclude Drilling

Since drilling through already-poured concrete slabs and walls is time-consuming and costly, it is sensible to install sleeves whenever



**FIELD SUPERINTENDENT** Stan Alexander (seated) and estimator Don Ross of Fischbach & Moore go into huddle before starting new project. Thorough understanding of the work involved, based on experience, frequently suggests practical methods leading to savings of effort which, in turn, favor the margins of profit. They also have discovered that it often is possible to increase profit margins by substituting more expensive items than specified, since costlier and better quality products may include construction features resulting in faster installation times. Since labor is a major factor of any over-all job cost, such savings can more than offset step-ups in product value.

the possibility of subsequent feeder addition may exist. This procedure may result in the establishment of a few unused or surplus openings, but installing a few more sleeves than necessary is far less expensive than leaving one out and having to install it at a later date.

For this same reason, the electrical job foreman must keep informed of progress of other trade groups, because a surprise pour can block a sleeve location, or necessitate later relocation. Therefore, work with other sub-contractors should be coordinated, this slight amount of extra precaution frequently saving many man-hours of wasted or duplicated effort.

Another truth is to the effect that "it takes money to make (and save) money," and progressive electrical contractors rarely hesitate in buying special "expensive" equipment when its use will improve job efficiency.

To illustrate, we recently purchased a telescoping scaffold that travels on its own wheels and resembles a mobile elevator consisting of a platform and an electrically operated lift. This piece of special equipment cost \$4600. It also provided us with a valuable adjustable-height moving working platform that materially reduced fixture-installation routines. These time savings paid for scaffold in two jobs.

Another major saving was obtained by combining some standard and special equipment to produce

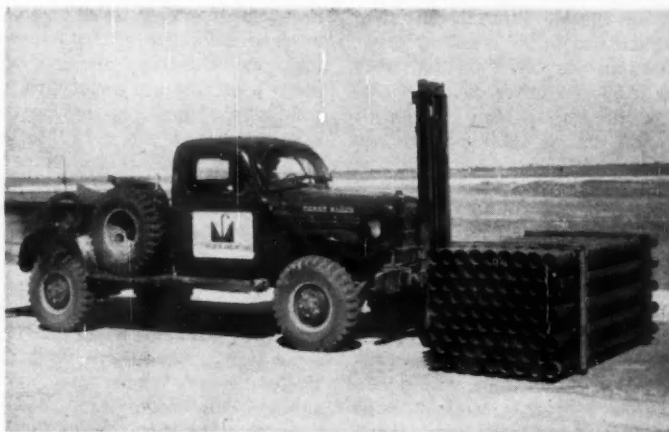
a useful installation rig on an airport project involving the placement of a million feet of conduit underground and parallel to several runways.

Normally, a truck could have been used to unload piles of conduit at spaced intervals, but this would have required men to then distribute conduit lengths for connection, thereby involving considerable materials handling, walking and consumption of time and energy. Our next thought was to use a fork

lift, but a standard one would not be able to move easily over the rough terrain of the field during construction.

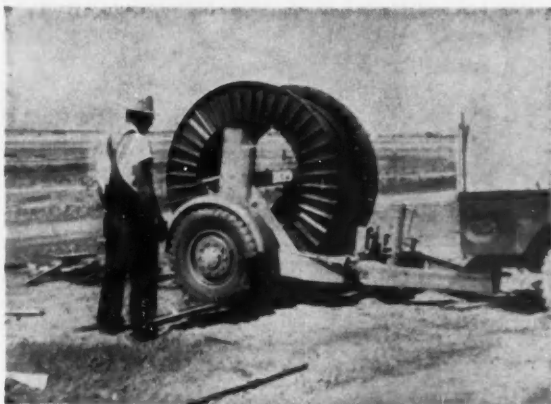
#### **Equipment Combinations**

Our eventual solution was to take the fork from a standard lift, then mount it on the front of a truck; the result being a fast-moving rugged fork-lift truck with lifting controls mounted in the cab. Savings came in several ways. First,



**FORK LIFT** was mounted on front of truck to permit fast mass-movement of duct sections on large underground distribution project. Ducts were first palletized for easy handling and, since truck could move over rough terrain and keep pace with the progress of duct-laying operations, workmen did not have to walk back and forth between central storage depot and the shifting point of work.





**HYDRAULIC DOLLY** permits one man to move large cable reel weighing 6 tons, the reel shown in this photo consisting of lead-covered 51-pair cable designed for direct burial along airport runway. Total installation involved over 30 miles of underground circuits.



**DOUBLE SET** of offset rollers, mounted on channel frame-work and 2-wheel trailer, guides cable from truck-hauled reel dolly to point overhanging open trench, thereby making it possible for a 2-man team to handle this assignment. Rig required 12 man-hours to construct, save many times that time during progress of job.

by binding bundles of conduit to pallets, a winch could lift quantities as single packages, thereby obtaining faster unloading of material. Second, since the conduit was moved along the trench as the work progressed, the men did not have to repeatedly retrace their steps walking to and from fixed conduit storage centers. And finally, since the men did not have to carry the conduits, we could order, handle and install longer lengths, this feature again lessening material handling routines and lessening the number of joints to be set up and connected. Over-all savings in time were substantial.

Another piece of special equipment is a hydraulic reel dolly which permits one man to load a 12,000-lb reel by himself. In one instance we combined this rig with a small 2-wheel trailer equipped with a Unistrut frame and double sets of offset rollers. This combination permitted us to efficiently trench-lay 165,000 ft of heavy direct-burial 51-pair lead-covered cable. As shown by an accompanying photograph, the trailer was hitched to the rear of the reel dolly and wire was fed through the offset rollers directly into the ditch, this operation being accomplished by a 2-man team. The unit represented an initial construction investment of 12 man-hours, but later savings in placement time amply justified this amount.

Many such time-saving methods and devices can be anticipated and planned before a job begins. But, after actual work is under way, it

becomes the major responsibility of the job boss to (1) exploit "breaks" that develop in the field under existing working conditions, and to (2) instill a cooperative attitude among his men.

Both of these assignments are important, because (1) no two jobs are exactly the same in all details, so local differences cannot be spotted in advance, and (2) construction crews differ basically from factory employees in that most of the men are hired for only one job at a time, rather than on a continuing basis. In industrial plants where foremen and supervisors are in long-term contacts with their men, morale and "company spirit" can be developed over extended periods. On construction projects, however, such morale has to be established quickly, and this attitude can be encouraged by a good foreman who leads his men instead of pushing them; who sets the pace rather than dictating it; and who welcomes all opportunities to praise his men for jobs well done. It is a general truth that most mechanics take pride in their workmanship, and an appeal to this attribute can be a valuable aid in engendering cooperation and loyalty.

#### **Mock-ups and Tests**

When considering the advisability of adopting mass-assembly or prefabrication methods, we frequently decide the issues by setting up test cases or by making mock-ups, then timing alternate installation procedures to determine which

combination of method and product is more efficient. This comparative approach is likewise taken whenever new products attract our attention, because we try to study and analyse them to see how they differ from comparable products already on the market, thereby determining for ourselves what advantages they offer in terms of performing a job better or faster.

In summary, it may be stated that electrical contractors can save time, effort and money by:

- 1) Ordering preassembled fixtures from manufacturers whenever the added cost is less than the equivalent labor cost of assembling units on the job.

- 2) Adopting prefabrication and mass-assembly methods to combine conduit runs with other components whenever feasible, especially on large projects where routines are repetitive.

- 3) Keeping informed at all times of the plans of other trade groups, conferring frequently with the general contractor and other subcontractors in order to coordinate efforts, and to plan electrical work to fit in with concrete-pouring schedules.

- 4) Constantly working to instill pride in crews of the moment, praising them for quality of workmanship.

- 5) Experimenting with equipment of your own design which might lead to greater job efficiency.

All of these things can result in reductions of installation time. And, in our business, time is a major item in the margin of profit.

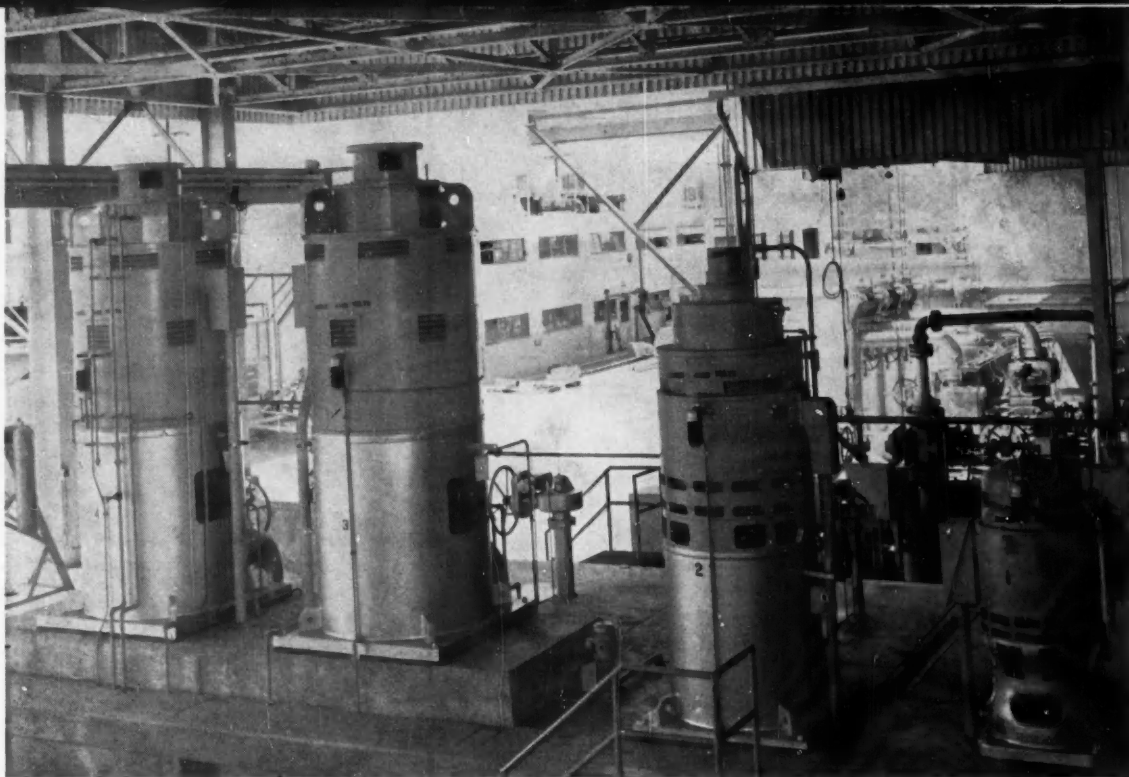


FIG. 1—Turbine pumps in high-flow laboratory (L-R: 2000-hp, 2000-hp, 1000-hp and 450-hp), with extensions on motor junction boxes to accommodate stress cones on shielded cables.

*High-voltage motors and low-voltage controls in . . .*

## Power for Rocket Engine Research

A close look at the extensive electrical power and control applications integrated in operations of a modern facility for development of rocket engines.

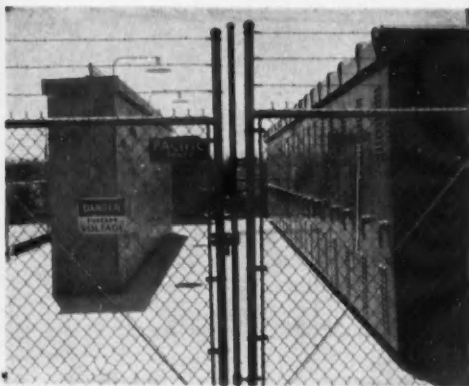
By **Braham Latch**, Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.

**T**HE early and continued success of the high-thrust, liquid-propellant rocket engines used on such operational missiles as the Redstone, Thor, Jupiter and Atlas is due in large measure to the extensive test and calibration facilities installed at the Rocketdyne Division of North American Aviation, Inc., Canoga Park, Calif. In this article, such facilities are described from a construction standpoint

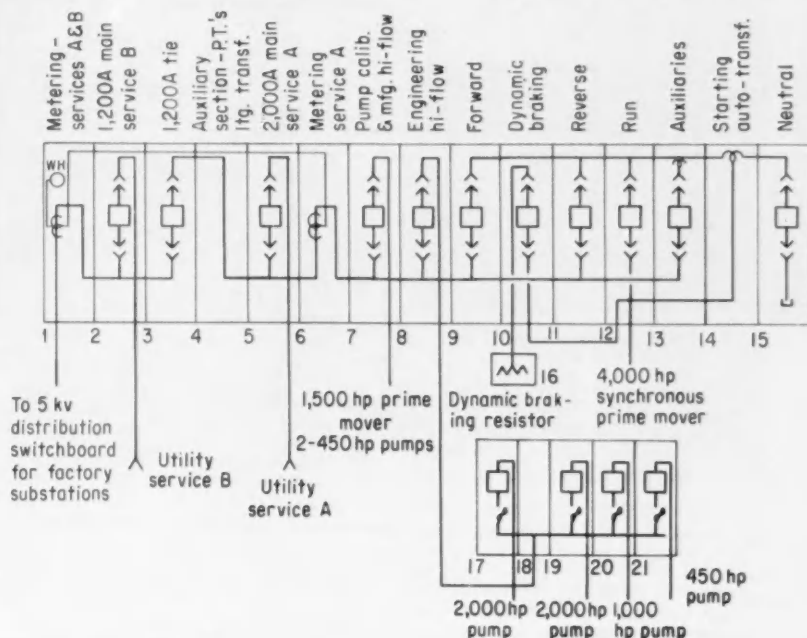
with particular reference to the constituent electrical installations.

It is of general interest to describe briefly the economic benefits derived from test installations of this nature. Savings are effected because this equipment permits the evaluation of design concepts and performance standards predicted by the theoretical efforts of research personnel prior to the establishment of a substantial and

costly hardware manufacturing program. After these initial efforts have indicated that one particular concept has sufficient virtue to warrant further development, then that particular concept can be tried and proved prior to engine firings where malfunctions are extremely expensive in dollars and calendar time. Also, with these facilities, individual components can be calibrated and mated to achieve a pro-



**FIG. 2**—Outdoor substation contains metalclad switchgear on right and starters for high-flow turbine pumps on left. Single-line diagram shows basic 4160-volt power hookup. Cubicles 1 through 5 were existing. Cubicles 9 through 15 comprise reversing metalclad starter for 4000-hp prime mover in the pump calibration facility. Units 17 through 21 are combination magnetic starters for turbine pumps in high-flow lab.



pulsion system of optimum performance.

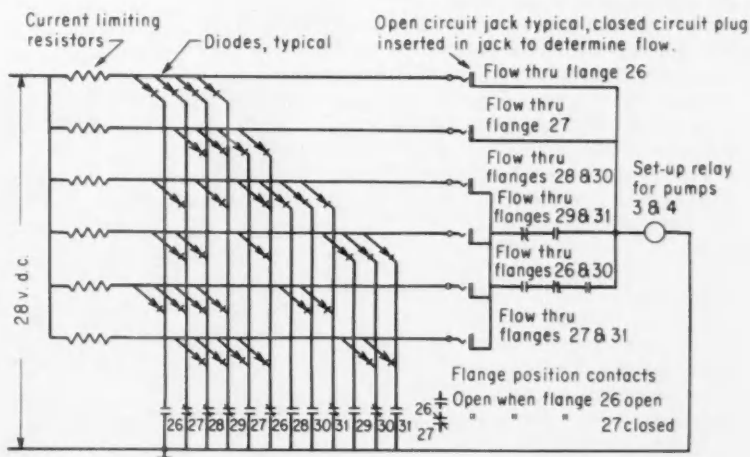
At Rocketdyne, the largest electrical rotating machinery installations used for testing and calibration purposes consist of a pump calibration facility and a high-flow laboratory. The pump calibration facility is so named because its primary function is that of calibrating the missile engine turbine pumps with respect to their pump horsepower. The facility for pump calibration has a 4000-hp and a 1500-hp synchronous motor, each driving its own speed-increasing gear box. Synchronous prime movers are required for turbine pump development work because all pump parameters vary in some direct relation to impeller rpm. Thus, the true effect of other variables (such as blade shape) can be determined only when angular speed is held constant, a requirement easily satisfied by a synchronous motor.

The high-flow laboratory is identified as such because the installation can reproduce the enormous flow rates required by a high-thrust, liquid-propellant rocket engine. The high-flow laboratory comprises one 450-hp, one 1000-hp, and two 2000-hp vertical turbine pumps, Fig. 1, which can be arranged, through proper manipulation of related piping systems, to supply as

much as 20,000 gal/min and to develop pressures as high as 1440 psig. This water-pumping plant is used to determine the efficiency, at various flow rates, of engine hydraulic components such as propellant ducting, fuel injectors, thrust chambers, and valves.

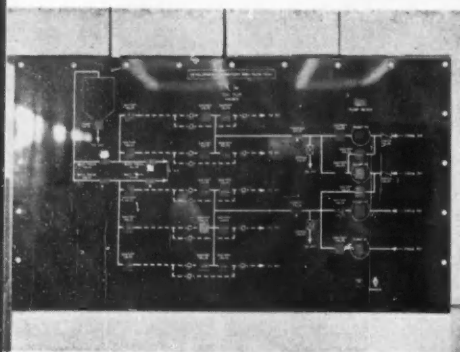
Electrical design of these installations was arranged to achieve maximum levels of safety, flexibil-

ity, operating smoothness, and economy of working space. The core of the electrical power installations lies within the outdoor, fenced substation, Fig. 2, which contains the 4160-volt, 4-wire distribution equipment as well as the motor starters for the high-flow turbine pumps. Although motor starters usually are not found within a fenced enclosure, they

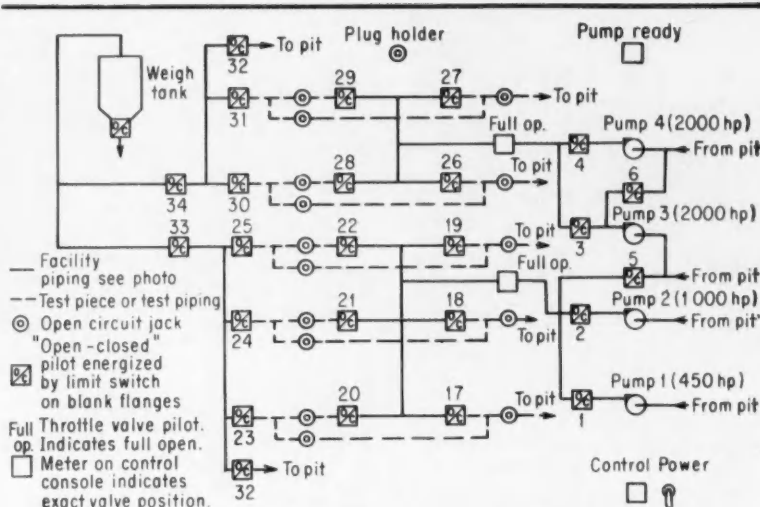


**FIG. 3**—Simplified schematic of high-flow control governing operation of high pressure pumps 3 and 4. Same scheme is used for pumps 1 and 2. Note that the set-up relay is energized only when two conditions are satisfied: 1. the flange path is completed by insertion of plug-in jack, and 2. this same path for control current flow is not grounded. Limit resistors are provided to prevent circuit damage in the event that an energized path is grounded.





**FIG. 4**—Graphic panel shows the piping flow schematic on a phenolic sheet. Diagram of the panel layout shows the flow control elements which correspond to flange numbers in Fig. 3.



were so located for this project to clear working and storage areas of bulky electrical gear, to eliminate the potential hazard of a high-pressure water stream striking a high-voltage starter, and to permit access only to qualified maintenance electricians.

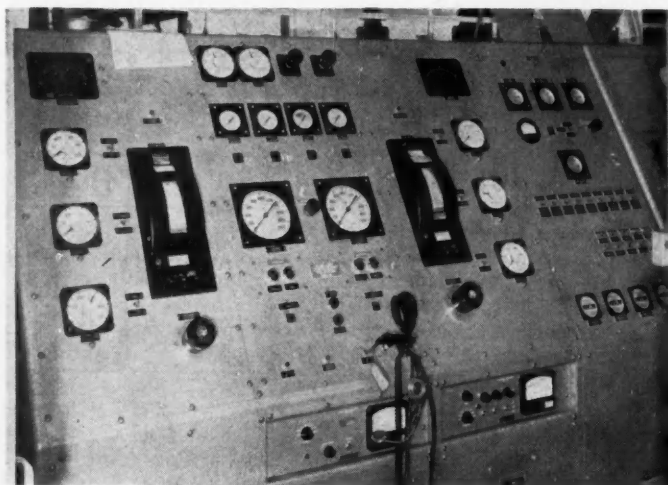
Distribution from the starters is accomplished with shielded, butyl-insulated, neoprene-jacketed, 5-kv cables in Transite ducts encased in red-colored concrete. Ducts for the high-flow facility are routed through two, full-size manholes, and terminate at a cast-metal pull box mounted on the wall of the facility's 190,000-gal. water reservoir. This box is installed 2 ft above the high-water level. Rigid steel conduit is run exposed from this pull box to each pump motor junction box. Although widely accepted practice would have allowed the use of unshielded cable from switchgear to motor, designers on the project believed that shielded cable should be utilized to limit the dielectric stresses which occur because of severe moisture conditions, steel-to-Transite transitions, and buried and exposed conduit routings. Custom extensions were fabricated for each motor junction box to allow sufficient space to make up a standard stress cone for the shielded cable.

Normal use of the high-flow facility often requires water to be discharged through open orifices of test hardware and then collected in the reservoir. Such procedures naturally result in excessive moisture conditions which demand an excellent grounding network for ef-

fective personnel protection. The City of Los Angeles Electrical Code recognizes and demands a ground conductor only in the same raceway as the circuit phase conductors. The facility ground was terminated at the ground stud on the motor starter enclosure and lugged to the motor junction box at the load end of the circuit. Ground electrode for this system is a 6-in. water pipe in the high-flow area. The code-required ground is supplemented by a network of 2/0 stranded copper which is bonded to building columns and other structural elements. And to insure ground continuity, even flanged pipe joints are equipped with bonding straps. The ground electrode for this auxiliary network is the utility's ground at the substation. Both grounding sys-

tems are connected at the substation with 4/0 copper.

To free work areas of needless obstructions and to minimize damage from water spray in the high-flow facility, all possible accessories such as exciters, pumps, filters, etc., are located on the control room roof, which is accessible by stairway. Power for these accessories is fed from the 480/277-volt distribution switchboard located in an alcove on the main floor. This switchboard also provides: 480-volt, 4-wire lighting; 480-240/120-volt, 37½-kva transformer for single-phase loads; 480-volt receptacles; and the motor control center which is adjacent to the switchboard. The motor control center contains circuit-breaker combination starters, each in its individual cell. For ad-



**FIG. 5**—Control console for the high-flow facility contains various control units and 3-amp plug fuses for protection of Class II control circuits.



ditional safety, each starter cubicle is provided with a control-circuit disconnecting toggle switch which is operable from the front panel.

There are several dozen possible hydraulic circuits, each composed of a variety of valves and blanked flanges which must be properly set to preclude a virtual deluge of water from emanating through open fittings. The electrical controls related to this system were designed to permit water flow through only one path at a time by shutting down all pumps if more than one path is in existence. Valves and flange blanks are fitted with position limit switches to indicate the closed setting of flanges and the open or closed position of valves. These switches, along with starters and relays, are combined in a control scheme not unlike that used in some solid-state switching networks, Fig. 3. This circuit is doubly safe. Not only must all limit switches for a particular piping path be closed, but the limit switches of wrongly positioned devices will cause the control circuit to be grounded, thus preventing any pump start-up. Diodes were used in the control circuitry because they offered decided advantages in space and cost reduction, and increased reliability compared to usual relay-type control.

The control devices are housed in the graphic panel cabinet, which is compactly arranged for ready maintenance. On the face of the cabinet is a graphic panel, Fig. 4, with the piping schematic painted on a phenolic sheet. Adjacent to each valve symbol are red (closed) and green (open) position-indicating pilot lamps. Also on the panel are read-out devices to indicate which pumps are running, a "Pump Ready" pilot and, most important, many open-circuit telephone jacks. Only one closed-circuit plug is provided. Insertion of this plug into any of the jacks is the means of selecting the one hydraulic path required for the test in progress. Valves and flanges related to this jack must be properly set for the controls to be active.

Adjacent to the graphic panel cabinet is the facility control console, Fig. 5, which houses "start-stop" controls for auxiliaries and pumps, indicating meters, position indicators for modulating valves, and various other read-out devices which enable operating personnel to be fully aware of the status of all high-flow machinery.

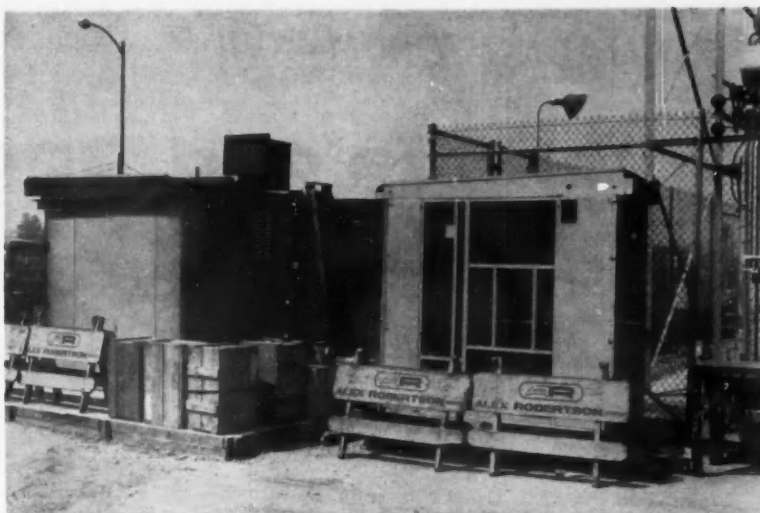


FIG. 6—Dynamic braking resistors for 4000-hp pump calibration motor were housed in 1200-amp metering section which was removed from switchgear cubicle to be replaced by 2000-amp section and was modified to take resistors. "Chimney" on switchgear, at left, provides for future extension of 4160-v line around autotransformer starter.

All control circuitry is wired to comply with the requirements of a Class II control system as defined in the Los Angeles Electrical Code. That is, systems operate at 30 volts or less and are protected with 3-amp overcurrent devices. Class II wiring is not required to be installed in a raceway system. This feature is of considerable importance to Rocketdyne since it allows the control circuits to be easily modified as new test requirements arise. Class II conductors installed on these projects are stranded, 16-gage conductors with nylon insulation. This wire is ideal for switchboard wiring and is tough enough for raceway installation. In addition, the jacket of this wire retains hot-die wire number stamping very well, which is important when connections are changed often.

The high-flow facility also is equipped with an instrumentation system to provide critical information concerning operating parameters of the hardware under test. In the test area, there are three panels equipped with dozens of jacks on which pressure- or temperature-sensing lines are terminated. These lines extend to signal-conditioning and graphic-recording equipment mounted in standard relay racks in the control room. Pressure pickups or thermocouples are mounted on the test or facility piping, and are plugged into appropriate jacks to complete the instrumentation system. It is interesting to those in the electrical

business to note that this impressive facility would be severely limited in its research and development capabilities if these pressure and temperature measurements could not be made.

The pump calibration facility was designed with the same attention to elements of safety, operating ease, and economy (Fig. 6) that characterized the high-flow facility. High-voltage equipment is kept remote from the testing scene by being located in the electrical equipment room. Equipment and cable selection, control schemes, and instrumentation considerations follow in the same general vein as for the high-flow facility.

The 4000-hp synchronous prime mover for pump calibration is of particular interest. This unit features accessibility and silicone insulation. The effectiveness of this insulation was verified by a test incident in which large quantities of water were directed at the motor intake louvers and discharged through the exhaust duct, with no detrimental effects to the motor.

The pump calibration facility was built by the Manco Construction Corporation with Preston Electric Company as their electrical subcontractor. The high-flow facility general contractor was Alex Robertson, Inc. Their electrical subcontractor was Royalty Electric Co. Complete design as well as construction supervision was accomplished by Rocketdyne's Facility Engineering Department.

# Volume and Operating Costs—Part I

By Ray Ashley, Research and Consulting Engineer, Oak Park, Ill.

## STATEMENT:

We are going to study the volume (annual) of business required to support electrical contracting operations employing various types of markups. This first part will analyze an established one-man business using substantial markups. Typical division of a proprietor's time is shown in Fig. 1 (from *Electrical Contracting*, McGraw-Hill Book Co.). Later, we will study a less substantial type of business operation (the 10 and 10 contractor).

The present discussion will cover an operation represented by the following set of conditions:

Amount invested in the business (excluding automobiles and trucks)—\$4,500.

Rents and incidental expenses are normal.

Average hourly rate for mechanics—\$4.00.

Proprietor's salary is 175% of a mechanic's salary.

The business is well established.

Markups on contracts are substantial.

Contract values are: maximum, \$40,000; minimum, \$100; average, \$2,000.

One half of the contracts were received without competition.

## QUESTIONS:

1. What would be the minimum annual volume required to pay expenses and earn a 10% profit on the above operation?
2. What would be the average number of mechanics employed?
3. In question No. 1, the proprietor's salary was \$14,000. If \$10,000 had been used, what volume would have been required?

## ANSWERS:

1. The annual volume would be \$132,000.
2. The average number of mechanics would be five.
3. With a \$10,000 proprietor salary, the annual volume would be \$110,000.

## DISCUSSION:

Study Fig. 1 to better understand the meaning of a one-man business operation. Besides the bookkeeper and general office man, the owner is the only one in the office. He is estimator, engineer, salesman, superintendent and general manager. How he divides his time is approximated in the table.

Operating costs and markups determine the necessary annual volume required to support the business. First, we must establish the operating costs. Fig. 2 lists those costs representative of the type of business under consideration.

**FIG. 1—A ONE-MAN BUSINESS\***  
Approximate Division of the Proprietor's Time

ACTIVITY	TIME PER WEEK	
	Percentage	Hours
Administrative .....	20	8.8
Estimating .....	25	11.
Engineering and layout .....	10	4.4
Superintending .....	15	6.6
Selling and making contacts .....	15	6.6
Purchasing .....	5	2.2
Billing and collecting .....	5	2.2
Miscellaneous .....	5	2.2
<b>TOTALS .....</b>	<b>100</b>	<b>44</b>

NOTES: \* From *Electrical Contracting*, McGraw-Hill Book Co.

There is no formula for allotting a proprietor's time. Such division of time for a new business varies considerably from that for an established firm.

The proprietor's salary is 175% that of a mechanic—or \$7.00 per hour compared to the mechanic's \$4.00 per hour. Most owners of an electrical contracting business work more than 40 hours per week. For our study, however, we have assumed a 40-hour week for 50 weeks—or 2,000 hours per year. At \$7 per hour, this gives a proprietor salary of \$14,000. Other values used in Fig. 2 are known to be representative of this type of business operation.

### Base Costs

Now, what portion of the total volume is used for operating expenses? To determine this we shall use a 100% base and add the percentages to be used in our example. Assuming a 60/40 material-labor ratio, our calculations would be as follows:

	Material	Labor
Base costs.	60	40
Direct job cost . . . . (2%) 1.20 (6%) 2.40		
	61.20	42.40
Overhead . (10%) 6.12 (35%) 14.84		
		57.24
Total cost—material . . . . 67.32		
Total cost—labor . . . . . 57.24		
Total installation cost . . . . . 124.56 (use 125)		

From the above we learn that, with the markups used, operating costs (direct job costs and overhead) are equal to 25% of the base job cost. Conversely, with the markups used, the total material and labor base cost for the job (annual volume) is four times the operating cost. In the example of Fig. 2, we find the annual operating cost of the business under study is \$24,000. To support this, the annual volume base cost (material and labor) must be four times this amount or \$96,000.

With the 60/40 M/L ratio, the \$96,000 base cost represents \$57,600 for material and \$38,400 for labor. To determine the estimated annual sales volume to pay the operating expenses of this business operation and make the 10% profit noted in Question No. 1, see Fig. 3. Here, the previously noted markup percentages are applied and a 10% profit added. The answer is a total sales volume of \$131,525. This is rounded out to \$132,000.

FIG. 2—OPERATING COST PER YEAR

Item	Amount
Proprietor's Salary . . . . .	\$14,000
Bookkeeper and general office man . . . . .	5,500
Rent (heat included) . . . . .	1,800
Electric bills . . . . .	180
Depreciation on equipment . . . . .	180
Interest on investment . . . . .	150
Telephone . . . . .	180
Automobile and travel expenses . . . . .	1,100
Insurances, stationery and miscellaneous . . . . .	400
Cartage . . . . .	300
Reserve for contingencies and guarantees . . . . .	250
<b>TOTAL . . . . .</b>	<b>\$24,040</b>
<b>Use . . . . .</b>	<b>\$24,000</b>

FIG. 3—EXAMPLE OF MARKUPS AND ESTIMATED VOLUME

	Material	Labor
Base Costs . . . . .	\$57,600	\$38,400
Direct Job Costs . . . . . 2%	1,152	6%
	58,752	40,704
Overhead . . . . . 10%	5,875	35%
		14,246
Total cost — material . . . . .	64,627	54,950
Total cost — labor . . . . .	54,950	
Total cost — the job . . . . .	119,577	
Profit . . . . . 10%	11,958	
<b>Total Volume — sales . . . . .</b>	<b>131,535</b>	
<b>Use . . . . .</b>	<b>\$132,000</b>	

### Number of Mechanics

To estimate the number of mechanics required, use the 2,000 average working hours per year previously mentioned. At a \$4.00 per hour rate, the annual payroll per mechanic would be \$8,000. Total mechanic payroll for the business operation (Fig. 3, labor) is \$38,400. Divide this by the \$8,000 per mechanic and you get 4.8 or 5 mechanics employed.

### With Owner's Salary Less

A short cut can be used to estimate the annual volume required if the owner took only \$10,000 instead of \$14,000 as his salary. The original operating cost estimate (Fig. 2) was \$24,000. A \$4,000 cut in

owner's salary down to \$20,000.

In the previous discussion we learned that the total installation cost was 125% of base cost and that operating costs were 25% of the base cost. In other words, the total installation cost is equal to five times the operating cost. Thus, five times the \$20,000 operating cost gives a required total installation cost of \$100,000. Add 10% for profit and you have a total sales volume of \$110,000 necessary to support the business operation—the answer to Question No. 3.

Here we have been dealing with an established business in a position to secure contracts with substantial markups. Later we shall see what happens to the beginner with lower operating costs and contracts with low markups.

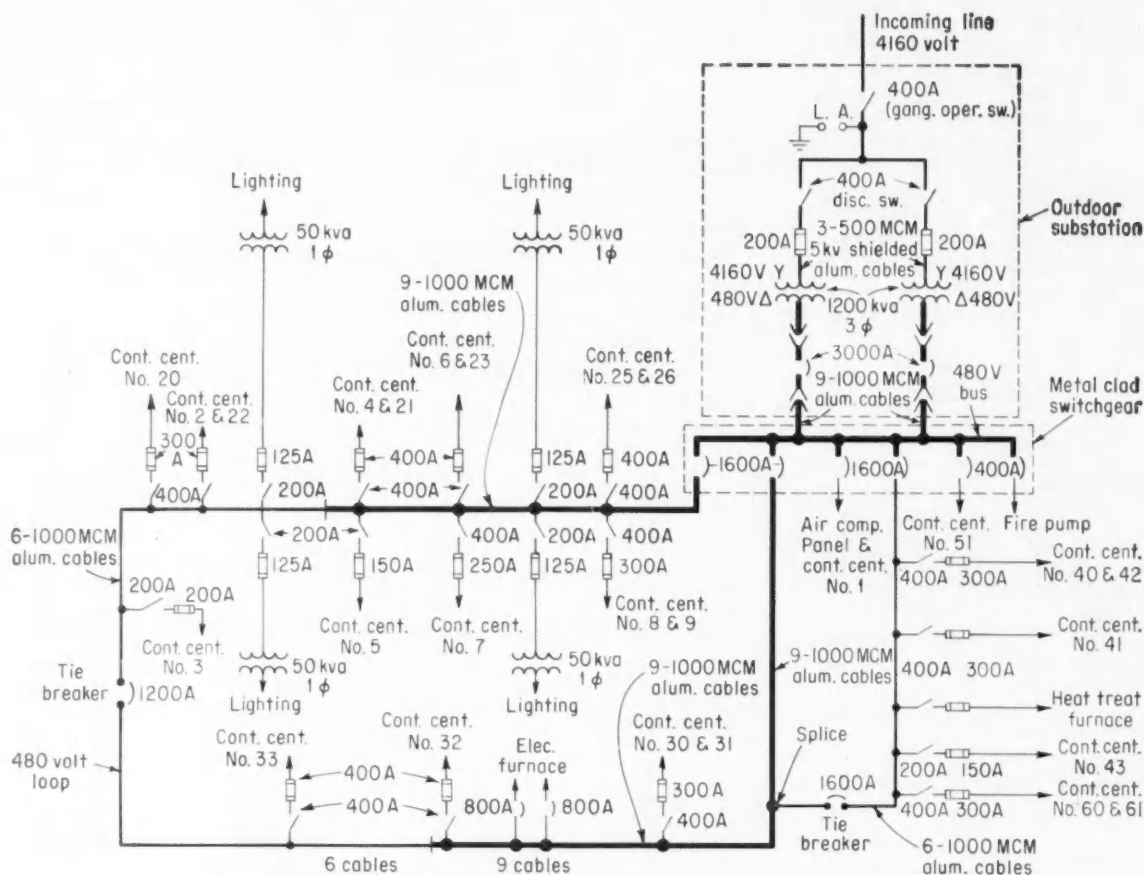


FIG. 1—Power distribution system, consisting of aluminum conductors, incorporates a feeder loop arrangement. In the 480-volt loop, nine 1000 MCM aluminum feeder cables are

run in parallel reducing to six conductors at the far ends of loop. Because of the comparatively distant run, parallel conductors are required to provide voltage stability.

## Planning for . . .

# New Plant Start-up

During design, construction and initial start-up of a new plant, electrical problems facing the engineer demand fast decisions. Here's how one electrical engineer met this challenge at ALCOA's die-casting plant in Edison, N. J.

**S**ELECTING new equipment, coordinating construction schedules, training craftsmen in the proper use of aluminum conductors and planning for electrical maintenance were but a few of the tasks accomplished by Lou Del Gaizo, Alcoa engineer, during construction of Aluminum Company of America's modern die-casting plant.

When Alcoa decided to build the

By Robert J. Lawrie

new 260,000 sq ft plant, Mr. Del Gaizo was assigned as project engineer in charge of electrical construction. While much of his previous experience was in electrical maintenance, Mr. Del Gaizo found that the new and varied construction problems facing him could be resolved through careful planning.

In addition to the construction phase problems, his responsibilities included electrical installation of all process equipment as well as design and layout of special circuits. Also, to meet the new plant's particular needs and to arrive at the most effective design, the plant's all-aluminum power distribution system bears many of his suggestions and innovations.

With a capacity of 2400 kva, the



plant's power distribution incorporates a loop feeder arrangement with 1000 MCM aluminum conductors run in multiple and installed in free air. Subfeeders supply motor control centers which provide centralized control for the process equipment. Much of the process equipment was transferred from the company's smaller Garwood (N. J.) die-casting works and from their Bridgeport (Conn.) permanent-mold foundry. These older plants were gradually shut down as the new plant was brought into production.

In the following personal interview, Mr. Del Gaizo discusses some of the various problems that he encountered and how he solved them. He also describes recommended methods of making aluminum conductor connections.

#### What were your main responsibilities as Project Electrical Engineer?

When I was assigned to this project, the over-all preliminary planning for the new plant had been accomplished. The architects and general contractor, Wigton Abbott Corp., Plainfield, N. J., and the electrical contractor, Fischbach and Moore, New York City, had been selected. And much of the electrical distribution system—its capacity and general scheme—had been designed.

During this planning stage, it was my responsibility to correlate the electrical distribution system to its ultimate loads making certain that feeders, branch circuits and distribution equipment selected were of proper type and size for safe, efficient operation.

At the same time, I was becoming familiar with the planned physical layout of process equipment in order to plan branch circuit installation.

During construction of the distribution system and installation of process equipment, I acted as consulting field engineer for Alcoa. Any deviations or changes and completion of work phases were approved by myself.

Other responsibilities included: moving of electrical equipment from the other plants into the new plant; coordinating electrical work with other trades; design of special electrical circuits; approving and testing all completed electrical construction and equipment installation.

Fifth in a series of articles on current industrial electrical maintenance. Previous studies were (1) Effective Large Plant Maintenance, April 1961; (2) Effective Small Plant Maintenance, June 1961; (3) Electrical Maintenance by Contract, August 1961; (4) Effective Maintenance Starts at the Top, October 1961.

#### What planning did you perform during the design and installation phases?

I listed all equipment to be moved into the new plant on check-charts. Data shown on these charts included: name of the apparatus, kva or horsepower requirements, voltage and current ratings, and information concerning special circuitry or equipment. When the move date became known, it was marked in a column provided. I examined all construction drawings, mechanical as well as electrical. In addition, all equipment drawings and instruction books were studied to insure proper installation.

To facilitate efficient and correct installation by the contractor, "typical" electrical layout drawings for similar machine installations and diagrams of complex electrical wiring were made.

Each week, the project engineer held a conference with the plant construction engineers to plan and coordinate future work. Also progress reports were made and anticipated problems were discussed.

A most effective device was the master progress schedule, which listed all phases of construction and contained the equipment move schedule. Besides providing a time table for planning, requisitioning, and construction, it afforded an over-all concept of the project.

#### What kind of power distribution and equipment was installed?

Our power distribution system can best be explained in a one-line diagram (Fig. 1). At the outdoor substation, two 1200-kva transformers step down 4160 volts to 480 volts delta, ungrounded. It is planned to establish a resistance grounding system in the near future. From each of these transformers, nine 1000 MCM aluminum cables carry the 480-volt power to an indoor metal-clad switchgear located at one end of the main building.

From the switchgear, two main feeders form a loop around the perimeter of the building. Each feeder is protected by a 1600-amp air circuit breaker. At the center of the loop (far end of the building) a 1600-amp tie breaker affords disconnecting means to isolate each half of the loop.

The system provides high reliability. With either feeder breaker open, 90% of all production equipment can be operated.

Also providing increased reliability, a third feeder which supplies smaller loads is connected into the main loop through a tie breaker.

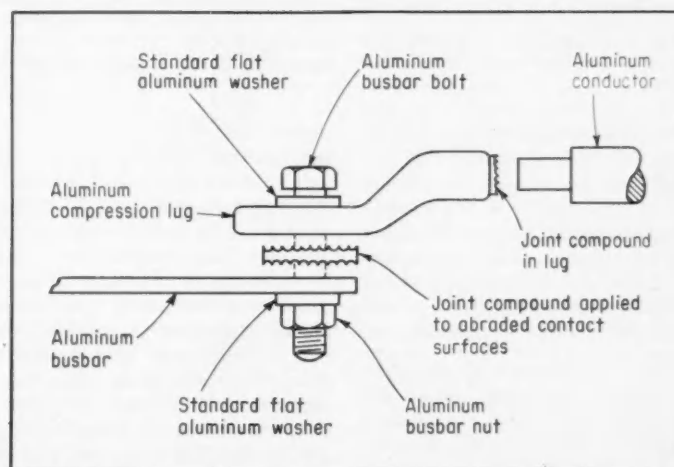
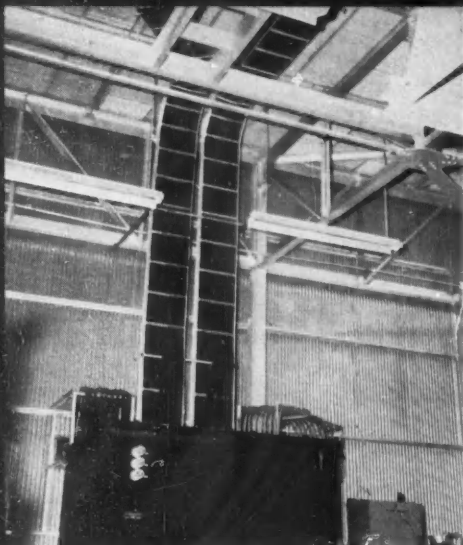
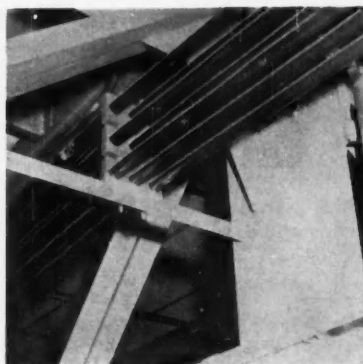


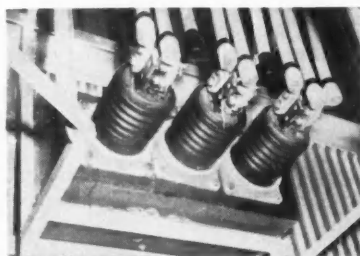
FIG. 2—Aluminum-to-aluminum connection requires proper preparation of contact surfaces. Contact surfaces of aluminum busbar and pad of lug are abraded with emery paper to remove high-resistance aluminum oxide. A joint compound is applied to prevent reoxidation. Cable end of compression lug may have surfaces previously prepared with joint compound in place. To obtain uniform thermal expansion all components are aluminum.



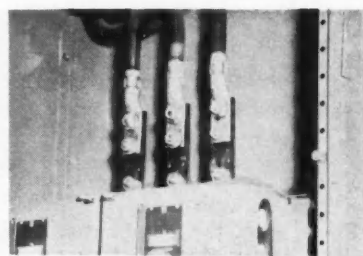
**TWO ALUMINUM CABLE TRAYS** carry 480-volt feeder conductors from the main switchgear in powerhouse to the processing areas. In process areas, the aluminum feeders are mounted in free air supported by cleats. Cubicle at left end of switchgear contains metering devices and ground indicating lights for the 480-volt distribution system.



**NINE 1000 MCM conductors** form part of the loop feeder arrangement. Because they are installed on cleats in free air rather than in conduit, the aluminum conductors have higher current-carrying capacity. This cleat support method allows easy accessibility of cables for troubleshooting or for replacement if necessary.



**WELDED-TYPE 90 DEGREE 1000 MCM** aluminum terminals connect aluminum conductors from outdoor substation transformer secondary breaker to main switchgear, three cables per phase. Connections are welded by the heliarc process, an inert-gas-shielded metal-arc process which provides optimum conductivity by fusing the aluminum cable strands and connector.



**COMPRESSION-TYPE ALUMINUM** terminals are joined to copper busbars at small control center. Contact surfaces of both the terminals and busbars are abraded with emery paper and a joint compound is applied. Abrading removes aluminum oxide and the joint compound prevents it from reforming. Crimp at cable end of the terminal is made with a hydraulic tool.

Sub-feeders are tapped off the main loop to fused disconnect switches equipped with high interrupting capacity fuses. Mounted overhead close to the loop conductors, these switches supply motor control centers, lighting transformers, or process equipment.

The one-line diagram shows nine 1000 MCM aluminum cables for part of the main loop circuit and six 1000 MCM cables for the remainder. What was the reason for that?

To provide voltage stability in the distribution system. The nine cables installed are more than ample to carry the currents involved,

but some of the cable runs are quite long. Each feeder consists of a sufficient number of parallel cables to be capable of carrying the expected loads without excessive voltage drop. With this system, it was intended that we could operate most of the equipment in the plant with one of the loop feeder breakers open. We recognize this as an emergency condition and plan to drop non-essential loads until the feeder breaker can be reclosed. Note that at the far end of the system, where electrical loads are smaller, the number of conductors was reduced to six. At several points, all of the conductors in each phase are connected together.

## Describe the method of installation of the 1000 MCM conductors.

In addition to the loop feeders, radial aluminum cable feeders from the metalclad switchgear were installed to feed nearby loads such as the fire pump, boiler room, air compressors and pump room. All of these outgoing cables, including the three loop feeders, are carried on aluminum ladder rack until the number of cables diminished to a point where it became economical to support them on polyester fiberglass cleats.

In the 480-volt loop circuit, polyester fiberglass cleats spaced every 15 ft support the 1000 MCM conductors in free air.

## Why was this installation design selected?

Main reasons for use of the tray and cleat support methods were: (1) Installation costs were greatly reduced. Cost of trays and cleats was considerably less than cost of required paralleled runs of conduit. Further savings in labor were obtained because the cleat-support system is much easier to install than conduit. (2) Conductors will have higher current-carrying capacity because they are mounted in free air rather than in conduit. (3) Conductors are readily accessible for maintenance or quick replacement if necessary. (4) Sub-feeders can be tapped off the main loop at any point and at any time.

## How were the sub-feed tap-offs constructed?

At the tap-off point, insulation is removed from each of the aluminum loop conductors. The sub-feeder cables are attached to the loop conductors with an aluminum parallel-groove clamp. The strands of the cable and contacting surfaces of the clamp were cleaned and an electrical joint compound was applied to assure trouble-free operation of the joint. The joints were then fully insulated.

Because of reduced wire size, fused disconnect switches are installed at the tap-off.

## What methods are used when making aluminum-to-aluminum connections?

Aluminum conductors can be joined by several methods. The simplest and most widely used methods are (1) compression connections, (2) welded joints, and (3) bolted connections.

### What is the proper procedure for making a compression-type aluminum-to-aluminum connection?

Normally, when insulation is removed from the cable, the surface of the conductor is clean and bright and does not require special preparation prior to installation of the terminal. Most compression terminals are prefilled with a joint compound which does an adequate job of cleaning the surface of the aluminum cable and breaking up the oxide. When the terminal is prefilled with joint compound, forcing the terminal over the end of the conductor, forces joint compound between the strands of the cable. Compressing the connectors, either with a hand compression tool such as is used on smaller conductors or with a hydraulic tool such as is used on larger conductors, will then force the connector and the strands of the cable together to form a solid mass and make good electrical contact. The joint compound then serves to exclude air and moisture from the joint and prevent re-oxidation of the aluminum.

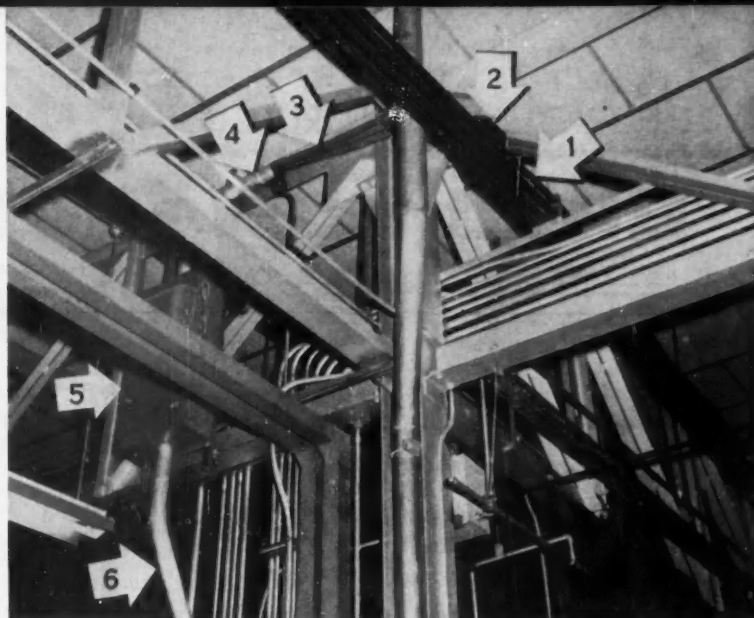
With aluminum, as with other conductor materials, a badly weathered or dirty conductor should be cleaned with a wire brush or with emery paper, before applying the connector.

Joint compounds are available from several manufacturers. Some are grease-type sealers serving only to seal out air and moisture. Others have metallic particles suspended in a grease-type sealer. These particles serve to break the aluminum oxide on the surface of the conductor and permit metal-to-metal contact. Some aluminum joint compounds are provided with chemicals which remove aluminum oxide.

### How do you make aluminum-to-aluminum bolted connections?

The interior surface of compression-type aluminum terminals has been protected from oxidation by the joint compound that was applied during manufacture. The connecting surface of the terminal pad, however, has not been so protected and should be cleaned by abrading the contact surface either with a wire brush or emery paper prior to the application of the joint compound.

This same procedure should be followed when making bolted connections with flat conductors such as bus. The use of aluminum busbar



**SUBFEEDER TAP-OFF** can be made at any point in the 480-volt loop. Arrows point out (1) loop feeder cables, two per phase, (2) taped splice using parallel-groove cable clamp, (3) subfeed conductors supported by cleat, (4) aluminum 90-degree elbow, (5) fused disconnect switch located within 10 ft of the loop conductors, (6) aluminum conduit carrying subfeed conductors to a motor control center.

bolts with oversized heads and nuts and standard flat aluminum washers are recommended for all joints with aluminum conductors. The aluminum bolt, as well as other aluminum components, has the same temperature coefficient of expansion as the aluminum conductor.

Use of steel, galvanized or cadmium-plated, or stainless-steel bolts, nuts, and washers is acceptable if Belleville spring washers are used. The Belleville washer, which is a saucer-shaped spring washer, compensates for differences in expansion of the steel and aluminum components in the joint.

### How are aluminum-to-copper connections made?

Normally, aluminum-to-copper connections are made in the same manner as aluminum-to-aluminum connections, using joint compound and abrasion cleaning of both conductors, and aluminum bolts or steel bolts with Belleville washers. In applications where the ambient temperature is extremely high or where very high currents are being handled, the use of an interposing bimetallic wafer is recommended. This wafer or washer should be installed so that its copper side is in contact with the copper bus, and its aluminum side is in contact with the aluminum bus. For additional effectiveness, joint compound should be used on both sides of the bimetallic wafer.

### How do you make aluminum welded connections?

Aluminum welded connections are usually made with an inert-gas shielded metal-arc process. Since the inert-gas shield excludes air from the weld area during the welding, no flux is required. This type of welding requires some special equipment and special training but our experience has proved that in areas where a large number of terminals are to be installed, the use of welding is economical.

### Do you have an electrical preventive maintenance program?

It's in the planning stage now. Our EPM program will incorporate past procedures used in our old plants plus whatever new procedures or methods that may be required for our new equipment. These new procedures will be selected after studying instruction books, the equipment in operation and reviewing past performance of similar equipment. We plan to set up a file on each apparatus or system and to follow a master inspection schedule.

Efficient scheduling will be most difficult. Certain equipment will require frequent inspections while others may operate for months without attention. Relying on knowledge of past performance of the equipment, we will schedule our electrical inspection and maintenance accordingly.



# Electric Heat Is Best

## ... Here's Why

The many advantages of electric heating are the most potent sales tool available for accomplishing a final, complete breakthrough to this ultimate in living comfort.

By Lowell R. Mast, *Electromade, Rochester, N. Y.*

**E**LECTRICAL energy has become so important a factor in our lives that it is one of the best indications of our standard of living. The annual consumption of electricity is closely related to the production of food, clothing, other necessities, and luxuries—indeed, our gross national product—as well as the state of our national employment.

It is not surprising that the many advantages responsible for electricity's tremendous growth should be extended to the heating and cooling of our homes, offices, factories and other buildings. Any discussion of these advantages as they specifically relate to electric heat involves making comparisons with fossil fuel systems. The fireplace and wood- and coal-burning stoves certainly were improvements over the open floor fires of our ancestors. Central units with their associated ducts and pipes added the refinement of distributing heat from its source to the space to be heated; introduction of oil and gas eliminated fuel-handling chores. Related temperature controls, a comfort and an economic necessity with such systems, became generally understood and accepted. Each system provided advantages over the system it replaced, and each fuel introduced was accepted on its merits regardless of the cost differential it represented.

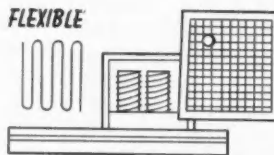
With electricity as the source of heat, further simplification is introduced: *only one energy source need be provided for the entire structure.* Fuel pipes and deliveries become a thing of the past. Electricity, carried by wires, automatically provides the many other benefits associated with the all-electric concept.

The advantages of electric heat are significant and real; they may be explored from many directions and for many very practical reasons. They deserve a closer look than is possible through the usual listing of attributes such as cleanliness, safety, flexibility, and trouble-free operation. They point the way to new comfort, new conveniences, and new economies; they explain the phenomenal growth of electric heat in the past decade and a half from obscurity to more than a million installations today—with unlimited potential for the future.

### Electric Heat Is Flexible

Most popular and widely used today are electric heaters using the resistance method of converting electrical energy to heat energy. Available in a variety of types, sizes, and styles suitable for almost all needs and individual preferences, resistance heaters comprise the most flexible method

#### FLEXIBLE



known today for producing heat. Many types are readily adaptable to installation in existing structures; all types are easy to install in new construction. No one type of heater, electrical

or otherwise, can fill all requirements. Electric heat, however, includes a choice of equipment types suitable for home, farm, industrial and commercial uses; for complete or partial heating applications; and for outdoor working and living. It can even make snow shoveling a thing of the past.

The same type heaters used for complete heating may also be used in a majority of cases for auxiliary or supplementary heat in newly built attic rooms, in rooms heated inadequately by the existing fuel system, or in new additions to the structure. Auxiliary electric heat possesses a strong selling argument to cost-conscious managers or executives of factories, commercial establishments, and institutions as well. Very often only a small amount of heat is required which is insufficient justification for starting and operating the main heating system. Likewise, there are many times when only a very small part of the establishment is being used, such as periods of overtime work, weekends, holidays, and inventory periods. Under such conditions a few electric unit heaters can show good returns on the investment.

Electric forced-air unit heaters can do double duty by providing air circulation without heat for comfort purposes during the summer months if they are wired to permit the fan to operate independently of the heating element.



## Electric Heat Is Durable

In many of today's new homes, fuel-fired systems may have to be replaced long before the mortgage is paid off to avoid inefficient and hazardous operation. In some cases, such situations may be temporarily remedied by rebuilding the heating unit. However, replacement is usually desirable because of the over-all cumulative deterioration due to the combustion process—and this may include all or part of the chimney flue. Where a central forced-air system is involved, considerable sheetmetal work may be necessary to accomplish the changeout, unless the new central unit is completely compatible with the old ductwork.

Ideally, electric room heaters should last the life of the structure. If they are built and installed on any other concept, it should be considered a waste of good material. Having few or no moving parts, they may require, at most, replacement of a heating element. This may compare in cost to a single cleaning of a fuel-fired system.

Where individual room heaters are used, there need be no fear of a complete shut-down for repairs. Other heaters will continue to operate if one should fail. Central electric furnaces should have much longer life than their fossil-fuel counterpart because of the absence of the combustion process. When failures do occur, simple replacement of parts will restore the system to its original condition and efficiency. Heat pumps also benefit from the absence of combustion. They have more moving parts than a furnace or boiler; but since they provide both heating and cooling, they must be compared with the combustible heating system plus a cooling system.

## Electric Heat Is Clean

Electric heat is as clean as an electric light. The process of converting electrical energy into heat creates no dirt, dust, vapors, fumes, or odors. There is no fuel to introduce dirt into the building, no smoke and products of combustion to dirty the exterior. Considerable savings in cleaning and redecorating costs are assured.

General wall discoloration is less pronounced where electric heaters are used. Lower heater temperatures and resulting smaller temperature differences between the heat produced and the ambient air, coupled with improved equipment design and air diffusers to deflect the rising heated air, minimize the amount and velocity of warm air striking the wall adjacent to the heaters. Convection currents, carrying suspended dust particles existing in the room air, cause the usual discolored walls surrounding forced air registers and steam and hot water radiators. In the case of a forced-air system, the problem is aggravated by the continuous circulation of dust not stopped by the furnace filter, which in most cases is very low in efficiency. Better filter systems or air cleaners, while they certainly are worthwhile when benefits are properly considered, have been used infrequently to date because of their influence on over-all cost.

CLEAN



Because of the heavier insulation and weatherproofing of an electrically heated structure, infiltration of cold air—and the dust it contains—is considerably less than that encountered in a structure built to conventional standards. This leaves essentially only the dirt brought in on shoes and clothing, given off by materials or substances used in the building, permitted to enter through open doors and windows, or resulting from cooking, smoking, or other activities—all of which are under the direct control of the occupant.

Thus, electric heat makes housekeeping easier. *It is the cleanest source of energy known for producing heat.*

## Electric Heat Is Efficient

So far as the conversion of electrical energy into heat is concerned, all types of electric resistance heaters are 100% efficient—all produce 3413 Btu per kw-hr of energy used. However, different heater types vary in *effectiveness*, an important consideration in their selection and application. The effectiveness is determined by the method used to transfer the generated heat to the space or area to be heated. Here, the specific need and individual preference dictate which type should be chosen to accomplish the desired result most effectively.

Published efficiencies of 70% may be ascribed to new gas and oil furnaces. Actual measured values, after a few years' operation, may be closer to half this figure, depending upon the extent and quality of the maintenance practiced. How much better, from the standpoint of efficiency and conservation, to use combustible fuels to power well maintained utility turbines and generators supplying electricity which can be delivered to the consumer and used at the 100% efficiency of electric heat. All electrical energy purchased is converted to heat within the space to be heated.

Since an electric heater requires no warm-up time, its 100% efficiency persists throughout the heating season. A combustible fuel system is less efficient in the spring and fall, periods of less frequent cycling, because full furnace capacity must be brought into operation with each start—even though only a fraction of its capacity may be needed. Seasonal efficiency of a system is of paramount importance in providing real comfort economically.

## Electric Heat Permits Accurate Control

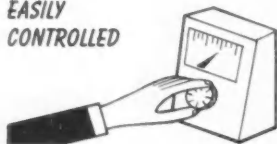
One thermostat cannot properly control the heating of today's modern, well designed home. Regardless of how good it is, a thermostat can measure only the temperature of the air around it. Where individual electric room heaters are used, each room has its own thermostat; heat is furnished only when the thermostat indicates that it is needed. This diversification is important, since heating requirements usually vary from one room to another. One section of the home may face the sun, while another is sheltered. There may be wide differences in the glass area, wall exposure, and occupancy, all of which influence the temperature which will produce the most comfort. Thus bathrooms, nurseries, or rooms used by elderly occupants may be kept at 80F, bedrooms at 65F, and the remainder at 70F.

With combustible fuel systems, on the other hand, such control would require costly motorized dampers

and other intricate allied equipment. As a result, a central thermostat usually operates the system in accordance with the temperature conditions at the thermostat. If that spot requires heat, all rooms get heat, whether or not their requirements are already satisfied at the time. Thus some rooms become overheated, and fuel is wasted. The usual solution to the problem is an open window. Conversely, a cold room remains cold until the space in which the thermostat is located needs heat.

Advantages of precision control with electric heat are not restricted to residential occupancies. Manufacturing plants, commercial establishments and institutions, such as schools and churches with varying periods and degrees

#### EASILY CONTROLLED



of occupancy, may be provided with heat only in rooms and areas at times it is required. The remainder of the building can be held at a lower standby temperature. Preparation of the room, zone or area for occupancy involves only turning up the thermostat sufficiently in advance of the time the space is to be used, and response is immediate. Program clocks may be used to make this flexibility of control completely automatic, according to a preset schedule. For example, unoccupied rooms of motels and hotels may be kept at lower standby temperatures until they are needed; then thermostats may be turned up by remote control from the desk or office. Considerable operating economy is effected through such flexibility of temperature control in any building partially or completely unoccupied for relatively long periods of time.

#### Electric Heat Provides Healthful, More Comfortable Living

Occupants of the electrically heated home should maintain a higher resistance to respiratory infections because of the higher relative humidity levels maintained. Experience and study of thousands of installations have shown that it is rarely necessary to humidify the electrically heated home. However, the fact that humidity levels are usually in the healthful 30-to-60% range is not a direct result of the use of electricity. Electric heat neither adds to nor detracts from the quality of the air. The higher moisture content is due to (1) the complete absence of combustion, and (2) the lower rate of infiltration of outside air into the well insulated and weatherproofed home which has become accepted as standard construction where electric heat is used.

These two factors are inter-related. The fossil-fuel heating system draws great amounts of air from the house interior during the combustion process, expelling it through the chimney. This tends to create a condition of partial vacuum. When the heating system is operating, cold outside air is drawn in through cracks around windows and doors by the pressure differential to replace the lost air. Because of the relatively loose construction of the conventional house, natural infiltration through the windward side of the house continues even when the heating system is not operating, driving warm air out the leeward side of the house. Since in cold weather the inside warm air usually contains more

moisture than an equal amount of cold outside air, this constant air change depletes the moisture content inside the house faster than it is built up by normal living functions, with a resultant drop in relative humidity. The low 10-to-20% relative humidity levels common in fossil fuel-heated structures promote an unnatural dryness in the occupants' nasal passages, paving the way for infection. A variety of humidifying devices, radiator pans, etc. built into the heating system attempt to alleviate the condition.

On the other hand, the well insulated construction, weatherstripping and double-glazing characteristic of the electrically heated house reduce infiltration of dry, cold air by  $\frac{1}{2}$  to  $\frac{2}{3}$  over conventionally heated and insulated buildings. There is no combustion process constantly using up some of the oxygen supply; air pressure differentials are virtually nonexistent. Generated moisture is thus contained within the building.

Occasionally there is a report of an undesirably high humidity condition. This usually can be corrected by the installation of kitchen and bath exhaust fans, and by venting the clothes dryer to the outdoors—steps which are usually taken during construction. Such ventilating provisions, plus suitable vapor barriers, should also dispel fears that a tight house will promote structural damage due to moisture.

Since exhaust fans are used intermittently and for short periods of time, the amount of heat lost is very small. Proper use of controlled ventilation in the electrically heated house will produce real indoor comfort; it can be a house that has an atmosphere of freshness, free from stale air and odors.

#### HEALTHFUL



The higher inside surface temperatures of fully insulated walls, floors and ceilings reduce body heat loss by direct radiation, the primary cause of chilly discomfort in cold weather

in poorly insulated structures despite adequate inside air temperatures. Comfort is thus experienced with electric heat at lower indoor air temperatures than is possible with fuel heat and less adequate insulation. The thermal inertia of a well insulated structure is such that the indoor temperature falls very slowly—only a few degrees after many hours without heat. Brief power outages, therefore, are not cause for much concern.

Some types of electric heating equipment also include as an integral function the generation of negative ions and the control of positive ions, claimed to have therapeutic value in reducing illnesses and discomfort caused by airborne bacteria. Continuing research in this field could promise increased benefits to health and comfort.

#### Electric Heat Is Quiet

Much design work has been done on quality resistance units to eliminate contraction and expansion noises present in earlier models as the heating elements were alternately heated and cooled. Forced convection units employ quiet-running fans; embedded ceiling cable is completely noiseless.

By contrast, most forced-air furnaces use large blowers whose operation, together with that of the oil burner or the gas nozzle, is usually noticeable in the house each time the thermostat cycles, particularly where the duct system is poorly engineered and installed. Hot water and steam systems are recognized through pipe hammer, piping expansion and contraction noises, and hissing of vents. Complete soundproofing of the furnace or boiler room, seldom practiced, can only reduce some of these noises.

#### QUIET



The noise-abating characteristics of increased insulation, weatherproofing, and double glazing also contribute in this respect.

Working as a team, electric heat and tight construction thus eliminate much internal noise and reduce external noise to provide a welcome sound-conditioned environment.

#### Electric Heat Is Economical

The best of anything is seldom the least expensive. However, electric heat can often be less expensive than conventional systems when a complete analysis is made of all factors affecting cost. With proper insulation and weatherproofing, electric heat is closely competitive today in operating cost alone with conventional fuels using conventional degrees of insulation. The very nature of electric heat enables it to provide the most benefits from recommended maximum insulation practices, benefits which do not apply in the same degree to other types of heating. Actually, insulation and weatherproofing pay for themselves many times during the life of a structure by savings in heating and cooling bills alone, and the prospect for a constantly decreasing operating cost differential is excellent. In the last decade, fossil fuel prices have risen steadily; electric rates have declined.

In addition, increased insulation reduces the capacity and cost of the required heating equipment. Other representative items of the over-all installation which must be investigated include the following: initial heating equipment investment, distribution ducts and related supports, chimneys, stacks and flues, dollar value of floor space occupied by equipment and fuel storage, incidental expenses related to fuel handling, controls and regulating devices, cost of insulation and of possible structural modifications necessary to accommodate insulation, smoke-control equipment, taxes, insurance, interest charges on initial investment, differences in sub-contracting contingencies existing because of choice of heat, cost of electricity needed to operate pumps, fans and other electrical equipment necessary for a fuel-fired system, salaries of heating-system attendants and maintenance men, and replacement parts and supplies used in conjunction with maintenance. Additional considerations will very likely apply, depending upon the specific nature or function of the building to be heated.

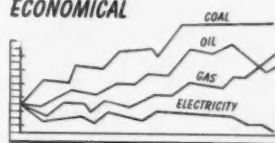
Most important, two heating systems cannot be compared unless necessary differences in structural design are recognized and provided for. The building must be engineered differently to realize the maximum advantage of electric heat; and electric heat

offers opportunities to develop new concepts of building design, construction and architectural techniques. The maximum economical thickness of thermal insulation, for example, varies with the type of building and the type of heating system employed. It simply is not good engineering sense to decide between electric heat and other types of heating for a residence on the basis of equal insulation thicknesses. Such insulation may mean less over-all monthly costs with electricity, taking into consideration energy bills, mortgage payments, and taxes, even though the monthly bills for other fuels may be lower. Proper cost analysis has often revealed that initial savings in construction by using electric heat will offset apparent lower fossil fuel cost for many years.

Additional cost advantages accrue to electric heat in multiple occupancies such as apartment buildings. Operating costs are lower for all "inside" apartments than single-family residences of the same size because of less wall, floor and ceiling area exposed to the weather. Top floor and corner apartments may have higher bills; but these units, more desirable to many people, usually command higher rentals anyway—and the tenant is willing to pay for it.

Metered electric heat makes it possible for apartment tenants to know exactly what their heating bills are. It is easy to budget energy bills, and no advance investment in fuel storage is required. Energy is paid for only after it is used. It eliminates

#### ECONOMICAL



wasteful practices, since each tenant can control temperatures to his own tastes. The apartment owner is relieved of the usual heating complaints. His maintenance costs are less, due partly

to the relatively trouble-free operation of the equipment, and partly to the elimination of maintenance personnel with boiler operating skills. An all-electric apartment need never become obsolete.

In summary, price and price difference alone should not be used as a criterion of value. No "yardstick" exists today that will accurately establish a uniform cost for installing a kilowatt-hour of electric heat, and no attempt should be made to establish such a value. True costs can be determined only by fully developing individual cases.

#### Electric Heat Has Important Allies

Electric heat has the supreme advantage of deriving its greatest support from its users, now numbered in the millions. Whether the decision to go all-electric comes after a careful consideration of all factors involved or as a "status symbol," the result is a growing family of enthusiastic boosters. Survey after survey among users of electric heat shows that over 90% recommend it to others and prefer it over their previous heating system. This is a satisfaction factor of higher value than ever experienced by combustible fuels. Most of these users have lived previously with a fossil fuel system. They thus have a more accurate basis for evaluating the benefits of electric heat, a basis available only to those who have lived with it.

Electric heat benefits from electric utility support, spurred on by summer air conditioning. Electricity is unique in that it must be used as it is generated;



it cannot be stored. Therefore, the generating capacity designed to handle the constantly increasing summer air conditioning peaks can be kept in use for the remaining greater part of the year for winter heating loads—instead of standing idle at great loss in revenue. The utility is interested in developing a load to off-set these peaks, and electric heat is the most logical choice. Therefore, increasing emphasis will be given to year-round comfort conditioning.

The connected heating load may be much greater than the connected cooling load in a given installation. This is due to the greater temperature differences in winter than summer. An overwhelming shift to electric heat could easily bring back a winter peak higher than the summer peak. As a consequence, the utility has good reason to insist on quality heating installations through effective reduction of heat losses which may occur through ceilings, walls, floors, windows, doors, and by air infiltration or exfiltration. A well insulated and weatherproofed structure will hold down power demand as well as reducing the customer's energy costs. Thermally balanced structures mean that more customers can be served using existing generating and distribution equipment. Strong utility support for quality and comfort is cer-

tainly welcome and is fast becoming common practice.

Other allies are entering the electric heat camp, sometimes from unexpected quarters. The coal industry, just about out of the space-heating picture, has begun intensive promotion of electric heat—with increased use of coal by electric utilities as the objective. Heating and air conditioning engineers, once they have designed their first electric heating installation and observed the results, usually become its enthusiastic proponents.

\* \* \*

Improved electric heating practices are removing the guesswork from conventional methods of calculating heat loss, aided by the kilowatt-hour meter. The story it has been telling is calling attention to errors and misconceptions of past heating practices.

We are entering today an era of real scientific heating—a step in environmental conditioning that has been long overdue. We are beginning to get serious about upgrading our standard of indoor comfort; and electric heat is destined to play the major role in awakening us to new and better ideas of just what true comfort means.

### Index to Electric Heating Forum Articles

#### EHF No. 1 (July, 1960)

"Design Heat Losses and Annual Energy Requirements," by Glydewell Burdick.

"Design Heat Loss and the NEMA Constant," by Howard S. Smith and Floyd Olson.

#### EHF No. 2 (August, 1960)

"Calculating Heat-Loss Factors," by W. J. Novak.

"Should the Utility Aid in Financing Electric Heat?" by Floyd Olson.

#### EHF No. 3 (September, 1960)

"Fresh Air and Humidity," by Glydewell Burdick.

"All-Weather Comfort Standard."

"Electric Heating Equipment Sales, 1959."

#### EHF No. 4 (October, 1960)

"Effect of Glass Area and Framing on Wall Heat Loss," by W. J. Novak.

"Heat Pump Compressor Capacity Test," by E. E. Umlang.

"Cost Comparison: Heating Fuels and Electricity."

#### EHF No. 5 (November, 1960)

"Infrared Spot Heating," by Lowell R. Mast.

"Sidewalk Snow Melting," by Aubrey G. Caplan.

"Electric Space Heating: Outlook for 1961."

#### EHF No. 6 (December, 1960)

"The Heat Factor," by W. J. Novak.

"Don't Short-Change Heating in Estimating Costs."

#### EHF No. 7 (January, 1961)

"Warehouse Floor Slab Heating."

"Input Control of Infrared Heaters," by Lowell R. Mast.

"The Case for the All-Electric School."

#### EHF No. 8 (February, 1961)

"Humidity and Condensation—I," by W. J. Novak.

#### EHF No. 9 (March, 1961)

"Humidity and Condensation—II," by W. J. Novak.

"Electric Space Heating Survey."

#### EHF No. 10 (April, 1961)

"Estimating Electric Heating Consumption," by W. J. Keller.

"Humidity and Condensation—III," by W. J. Novak.

#### EHF No. 11 (June, 1961)

"Selling Electric Home Heating," by Stuart M. Rich.

"Humidity and Condensation—IV," by W. J. Novak.

#### EHF No. 12 (August, 1961)

"Houses for Electric Heating Research."

#### EHF No. 13 (September, 1961)

"Humidity and Condensation—V," by W. J. Novak.

"Heating Contractors, Plumbers, and Electric Heat."

#### EHF No. 14 (November, 1961)

"Humidity and Condensation—VI," by W. J. Novak.

#### EHF No. 15 (January, 1962)

"Electric Heat Is Best—Here's Why," by Lowell R. Mast.



# NUCLEAR ATTACK AND INDUSTRIAL SURVIVAL

The Editors of McGraw-Hill consider this report the most critical assignment ever undertaken by our segment of the business press of this nation. In its development, at one moment or another, each member of the task force has felt the enormous contemplative weight of the subject and the almost overwhelming demands for accuracy. Rarely have we dealt with a matter of such potential import to individuals and to responsible leaders in all segments of the American economy. Never before have we volunteered as much effort, hoping it would not be needed.

However, not only now during the Berlin crisis, but probably for many years to come, the U.S. will live under threat of a nuclear attack. How well we could survive such aggression, and how rapidly we could restore a viable civilization, depends heavily on how we prepare to meet the danger.

And yet, paradoxically, we are aware that the very effort to do this work . . . or even to address this subject . . . is controversial. There are those, in highly respected echelons of our society, who say no civil defense is worthwhile . . . that the more security you feel, the more willing you are to risk the holocaust.

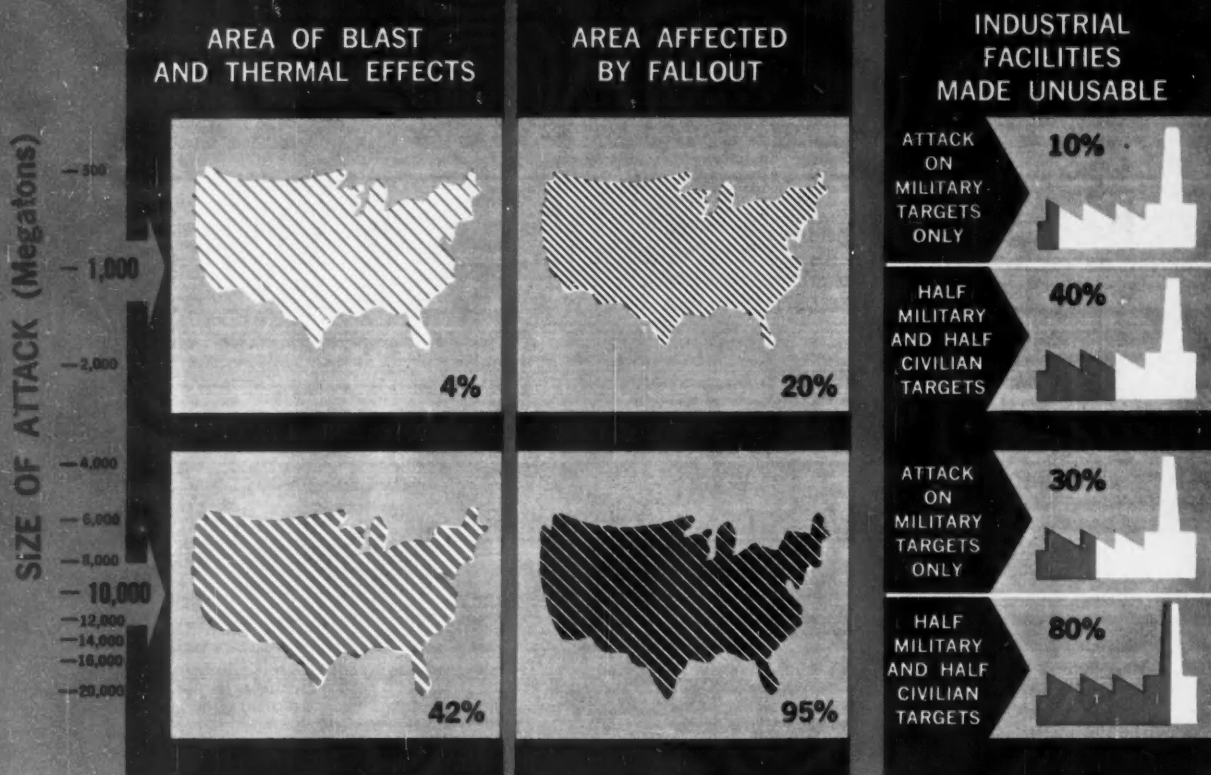
- Our study of nuclear attacks, and consultations with experts both within government and outside, convince us that responsible and prudent management can, and should, act on the basis that protective measures constitute a sound form of insurance.
- We believe the suggestion that a sense of security might provoke aggression libels both the intelligence and the morals of the American people. Nothing in this report, or in any other realistic appraisal of this somber subject, encourages aggression or bravado. On the contrary, the awe-full dimensions of destruction . . . despite all preparations for protection . . . compel the utmost effort for prevention of nuclear war.

This report concentrates on the problems of U.S. industrial survival for two important reasons. First, the excellent organization that industry already has can be a powerful force for the protection of people. Second, in the aftermath of any war, it is vital to society that production be restored as quickly as possible. Therefore, in planning for both survival and recovery, business and industry have special responsibilities . . . to employees, to the community, and to the nation.

Let us make one thing absolutely clear. If any part of the pages that follow can be accused of sensationalism, then we have failed our job. The Editors of McGraw-Hill do not believe that nuclear war is likely. But we do believe that the possibility of it . . . however remote . . . must be examined.

The Editors of McGraw-Hill

PUBLISHED AS A SERVICE TO INDUSTRY BY MCGRAW-HILL PUBLISHING COMPANY



**ESTIMATED EFFECTS OF NUCLEAR ATTACKS** at a clearly credible present level (1000 megatons) and a possible future level (10,000 mt). Individual bombs assumed to be 10 mt with 50% fission yield; half are surface bursts, half air bursts. Area figures assume no overlap between air bursts, 50% overlap of surface bursts. Limit of thermal-

effects area taken as 2nd-degree-burn level; this automatically includes all blast-damage area. In fallout-affected area, precautions would be needed to avoid radiation sickness or death (first-day dose is 200 r, or more). In combined military and city attacks, military targets were assumed to receive all surface bursts and city targets all air bursts.

## THE DIMENSIONS OF DISASTER:

### What might nuclear attacks cost us in facilities, people?

Because no nation has ever suffered a full-scale attack employing modern thermonuclear weapons, there is no direct experience to use as a basis for appraising the damage the U.S. would suffer under such an attack—or for gaging what government, industry, and others in the community might do to provide protection.

To assess the damage in advance, you must turn to data drawn from painstaking studies of the relatively small attacks on Hiroshima and Nagasaki, and from the tests conducted in the years since.

These give reasonably precise knowledge of the effects of a single explosion. And they make it possible, with only slightly less precision, to calculate the effects of a known pattern of bursts.

**Attack estimates.** To estimate the results of large attacks, however, you must assume a range of factors: total size of attack, size of individual weapons, type of burst, and—most controversial of all—the nature of the targets. In other words, you must try to divine the enemy's strategy. Any estimates you produce reflect the assumptions with which you begin.

In the chart above, you see an attempt to picture the range of possible attack—from a level that is credible now

to one that might be credible in the future. It also shows the effects of some of the variables. For example, in this case the assumption is made that 10-megaton weapons would be used. Of course, it is possible that an enemy might employ bombs both larger and smaller than 10 mt, with somewhat different results.

Another important variable is the burst pattern. Surface bursts do the most blast damage to missile sites and airfields, hence might be chosen for military targets. They also yield radioactive fallout that can kill people and disrupt life many miles from the target. On the other hand, air bursts inflict blast and fire damage on two to three times more area. These might well be used against "soft" military targets and centers of population.

**Target selection.** Biggest variable of all is the enemy's selection of targets. The chart shows two patterns for each level of attack: one concentrated on military targets, the other divided equally between military targets and cities. In both cases, half the bursts are in the air, and half are on the surface.

The smaller attack, directed partly at cities, could actually cause more deaths and damage to industrial facilities than would the larger attack aimed solely at military tar-

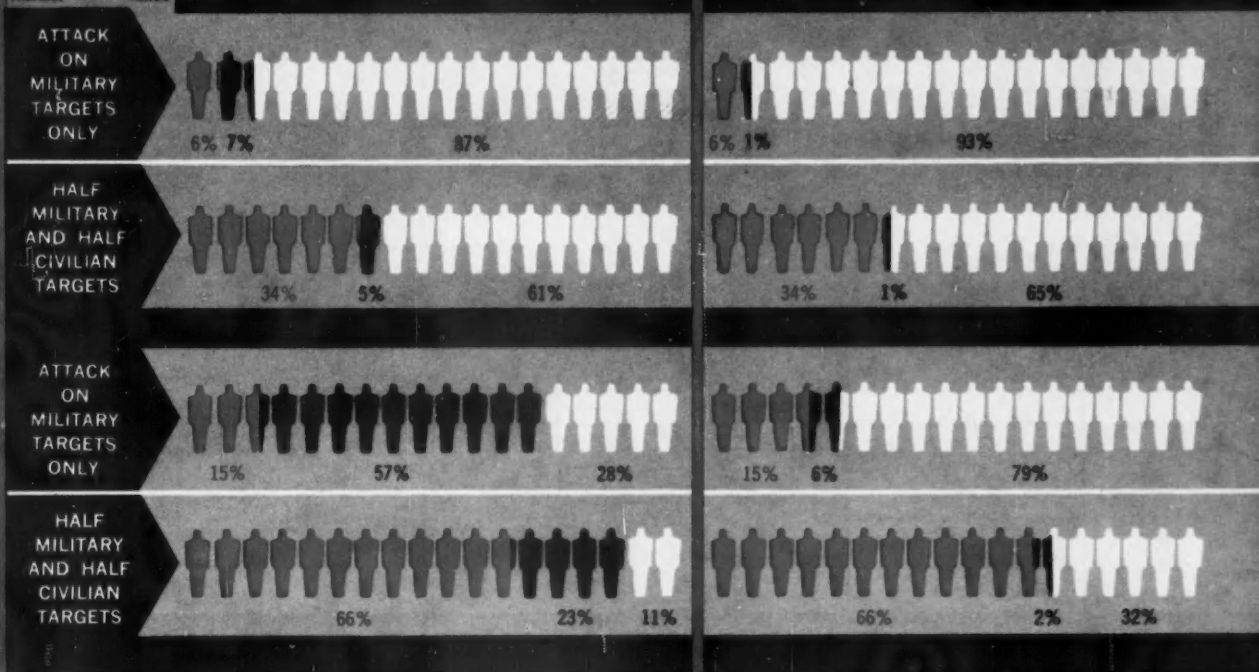


10 million

## FATALITIES AS % OF TOTAL POPULATION

### WITHOUT SHELTER

### WITH FALLOUT SHELTERS



For industrial facilities, "made unusable" means destroyed or requiring major restoration after blast or fire. Fatalities "without shelters" assumes poorly instructed population with no shielding beyond ordinary housing. "With fallout shelters" assumes informed, well disciplined population fully equipped with good group shelters. No

account is taken of blast and fire protection afforded by fallout shelters. Fatality figures do not include deaths from secondary causes such as lack of medical treatment for injuries. Estimates based on data from Office of Emergency Planning, Atomic Energy Commission, Rand Corporation, and hearings of the Joint Committee on Atomic Energy

gets, because industrial facilities tend to be concentrated in or near centers of population. These figures point up the crucial role targeting would play.

The chart at right above shows what might be accomplished by a really good protective program — a goal that could be reached only by a major change in the nation's present unprepared posture. It should be noted that the chart assumes a one-day war; losses would be different — and probably greater — if a big attack were followed by several smaller ones.

Imperfect as such estimates must be, what can they teach us? How should we interpret them?

Clearly, these figures — and those of other authorities — reveal the sheer size of the problems posed by nuclear attack. Right now, a single blow could cost us 40% of our industrial facilities and, without protective measures, 39% of our population.

**Destruction varies.** In assessing this grim picture, it is important to realize that destruction would not be universal. Nor would it be uniformly distributed. Some areas would be essentially unaffected. Others, nearer targets, would be physically untouched but contaminated by fallout. Closer in, there would be areas with even greater fallout concentrations, plus fire damage. Moving in still closer, blast damage would be heavy, and fire and fallout would make conditions still worse. Finally, there would be centers of virtually complete destruction.

It should be clear that no company management can predict which of these varying degrees of destruction might hit its facilities. It is equally clear, however, that there

would be many areas in which protective measures, such as shelters, would be effective, as the casualty figures demonstrate. And the "graded" nature of the damage offers some clues to the approaches management might take in planning for survival — approaches that will be examined in more detail later in this report.

Finally, this effort to gage the dimensions of the disaster resulting from a large-scale nuclear attack gives some idea of the environment in which individuals and companies must try to rebuild. There would be no "business as usual", even in the relatively unscathed areas of an economy that has suffered major disruptions to the services on which industry depends — communications, transportation, utilities, raw materials, fuel, food, money and credit, to name some. This glimpse of the post-attack period gives urgency to efforts to plan now for the problems of the recovery.

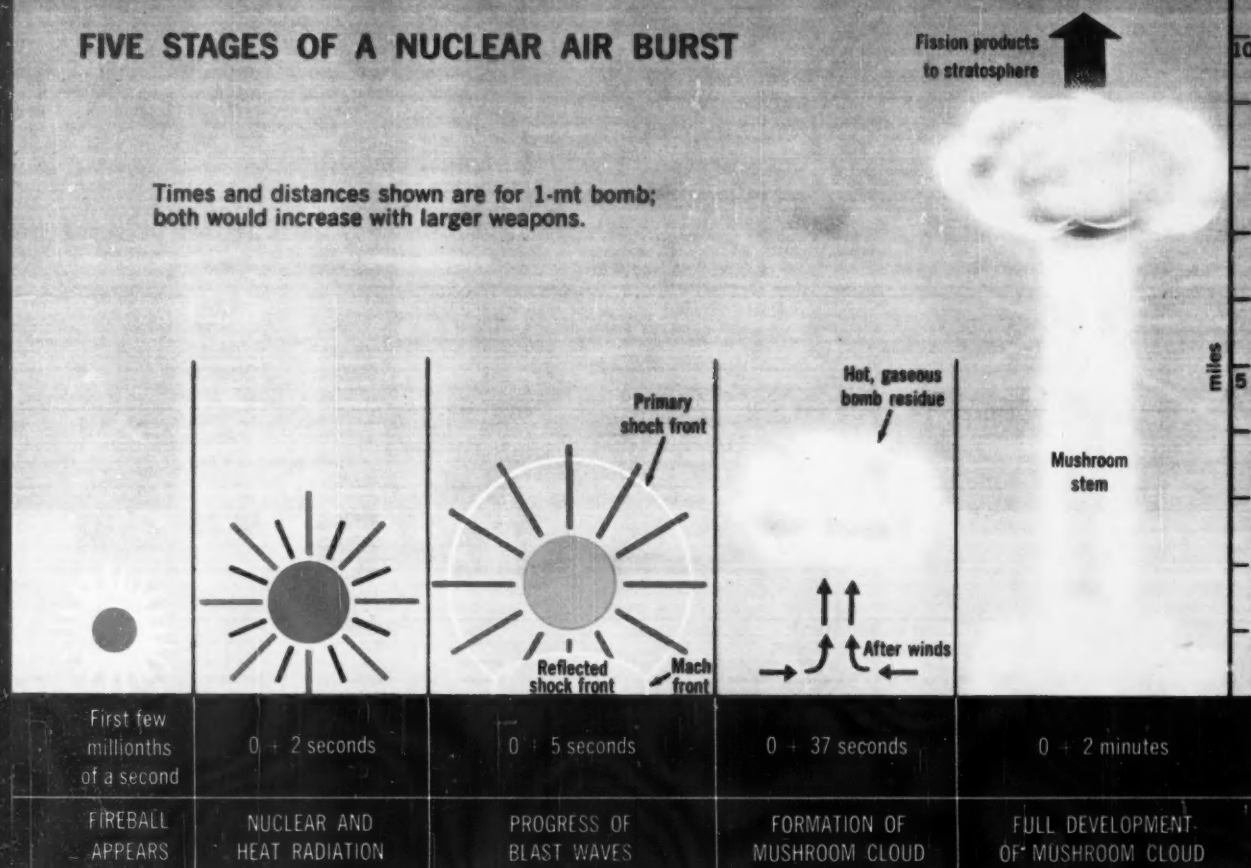
**In the following pages, this report tells business and industrial management what it needs to know about:**

- The effects of nuclear attack — fire, blast, fallout . . . . . pages 4-8
- Plans to make in advance for surviving an attack . . . . . pages 9-13
- Preparations that can be made for post-attack recovery . . . . . pages 14-16



## FIVE STAGES OF A NUCLEAR AIR BURST

Times and distances shown are for 1-mt bomb; both would increase with larger weapons.



1. Instant release of bomb's vast energy raises temperature of its materials several millions of degrees, gasifies them to form a roughly spherical luminous mass. Emitting nuclear and thermal radiations, this "fireball" grows and rises. For a 1-mt weapon, maximum diameter of 1.4 mi is reached in about 2 seconds. Very shortly after explosion,

shock wave develops and moves rapidly away from fireball. When shock wave reflected from earth surface meets primary wave, the reinforced "Mach front" forms and moves outward. Rising ball of fire, no longer luminous, creates strong updraft and "after winds" that raise dust and debris. With condensed bomb residue, these form radioactive cloud

## NUCLEAR EXPLOSIONS: What are the immediate effects?

The split-second blast of a modern nuclear weapon lets loose awesome amounts of energy — so awesome, in fact, that it is usually measured by comparison with the force of thousands or millions of tons of TNT (*kilotons* or *megatons*). It would take a block of TNT the size of New York's Empire State Building to duplicate the energy release, or *yield*, of a 2-megaton nuclear bomb.

How can you pack that much wallop into the warhead of an ICBM? The answer lies in the way a nuclear explosion unlocks the vast forces inside the nucleus of the atom. There are two techniques for doing this:

- In *fission*, you split the nucleus of a heavy element — such as uranium-235 or plutonium — into two lighter nuclei, called *fission products*. If fission were 100% complete — it isn't — 1 lb of U-235 would produce the energy of 9000 tons of TNT.

- In *fusion*, you cause two light nuclei to unite into a single heavier one. Fusion will create, from the same mass of material, nearly three times as much energy as does fission. But to trigger the fusion process, you need temperatures akin to the heat of the sun. To produce this heat, you use a fission explosion. Fission triggers fusion. Then, as an extra

dividend, more fission results because fusion liberates high-energy neutrons that split some of the atoms left intact by the first fission. This combination — fission, fusion, then more fission — adds up to the terrible energies of today's thermonuclear weapons.

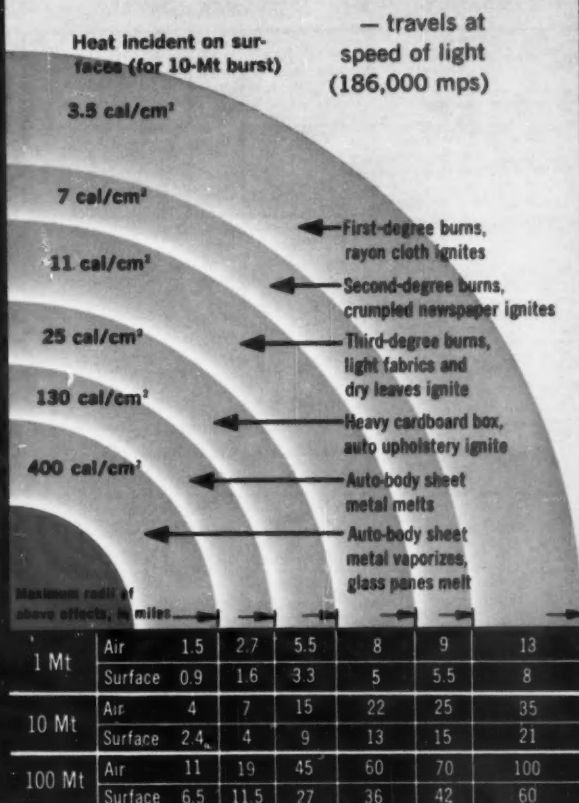
**Sequence of events** in a nuclear explosion appears in Fig. 1, above. First there's a flash of light that can be literally blinding — eyes turned directly toward it suffer retinal burns, even at distances of hundreds of miles with megaton blasts. How much damage is done to the eye depends on such factors as weapon size, height of burst, time of day, weather, and speed of blink reflex.

Millionths of a second after the bomb is detonated, the *fireball* forms and grows by engulfing surrounding air. In about two seconds it reaches a maximum diameter of 1.4 mi for a 1-megaton (1-mt) bomb. Maximum diameter is 3.4 mi for 10 mt, 4.6 mi for 20 mt. When the burst is low, and the fireball touches earth, all above-ground installations within it are vaporized or otherwise destroyed, except for heavy concrete structures.

Simultaneously, the explosion releases an initial burst of radiation — about 5% of the bomb's total energy — that is



## THERMAL RADIATION



2. About 35% of total bomb energy goes out in a burst of heat, uniformly radiated. Heat level falls rapidly with distance, as shown in calories per square centimeter at successive circles, above. Figures below give clear-day radii of circles for three weapon sizes, two types of burst. Also shown are possible effects on materials, people

itself lethal over an area about the size of the fireball. This radiation includes high-energy neutrons and gamma rays. Additional gamma rays come from radioactive bomb materials and fission products.

**Heat and fire.** The fireball sends out *thermal radiation* in two pulses, making up 35% of the bomb's total energy. The first pulse, a split-second ultraviolet flash, isn't a major hazard. But the second is: mostly infrared, it carries nearly all the heat of the burst, lasts several seconds. As the heat radiates from the fireball, it spreads over ever greater areas, so heat levels diminish sharply with distance (Fig. 2). Low clouds or fog tend to cut heat, but high clouds can act as reflectors, raising heat levels on the ground.

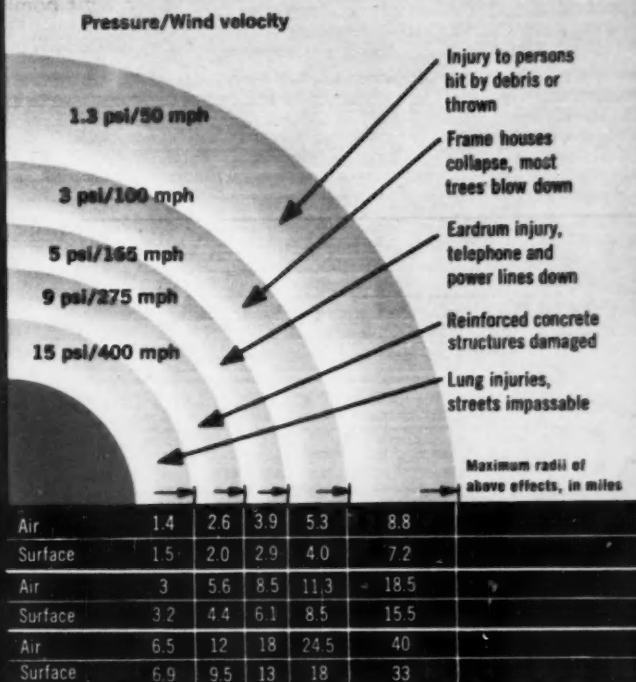
Because heat is applied only for a matter of seconds, light, easily kindled materials are most likely to ignite. But surveys show typical American cities contain 5 to 25 points per acre where fires might begin from thermal radiation. Although it's hard to predict precisely, there's a danger that many small fires might merge into single, great "firestorms", with strong updrafts at center creating violent cyclonic winds.

Thermal radiation travels like light. So ducking quickly into a shadow or covering exposed skin with clothing offers some personal protection.

**Shock pressures.** In about the time it takes for a thunderclap to follow a lightning bolt, the blast wave fol-

## BLAST

— travels faster than sound (over 770 mph)



3. About 50% of bomb's total energy goes into blast; the front of the blast, called the "shock front", travels rapidly away from the fireball, behaving like a moving wall of compressed air. Chart above shows various levels of blast pressure, equivalent wind velocities, and possible effects in the annular zones between successive circles

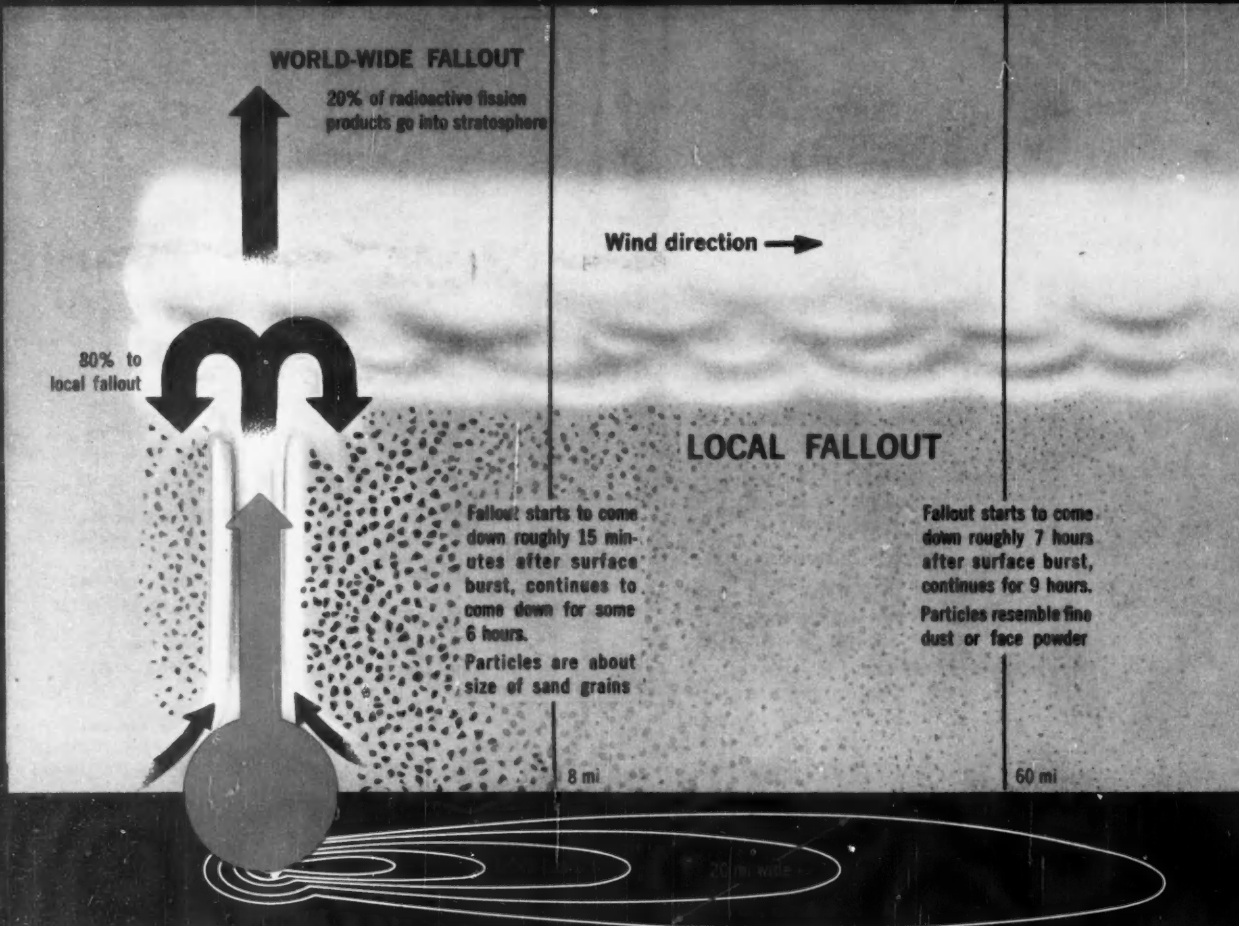
lows the thermal flash; about 50% of weapon energy is in this form. The blast wave starts as a high-pressure shock front, traveling somewhat faster than the speed of sound. After a few seconds, a negative-pressure phase follows. The effect is to first squeeze and then expand or explode structures and human tissues.

Along with these great swings in pressure, there would be short wind gusts of enormous velocities—up to 1000 mph near ground zero. Drag forces of these winds would inflict much of the damage to buildings and the bulk of blast injuries to humans. As Fig. 3 shows, shock pressures in themselves would be fatal over only a small area by comparison with the area in which pressures and winds would hurl people and objects through the air to cause injury and death.

Near ground zero, pressures and winds are higher in a surface burst than an air burst. Farther out, an air burst creates stronger pressures and winds because the blast wave bounces off the earth and reinforces the primary wave to create the so-called "Mach front" (Fig. 1).

In areas of heavy blast damage, fires will be started by broken gas mains and electrical short circuits. They will feed on the kindling produced by the blast.

Thanks to the relatively slow speed of the blast wave, there is often time to take evasive action, such as dropping flat, or seeking shelter below ground.



4. In contrast to air bursts (Fig. 1, page 4), where fallout goes mainly to the stratosphere and may travel far, surface bursts are characterized by heavy local fallout. This results from great amount of debris swept up into the fireball. Like the materials of the bomb, such debris is initially vaporized. Material swept up later may be

only melted. When the vaporized materials, including fission products and materials made radioactive by neutron bombardment, condense into fine particles, many of these adhere to larger debris particles. Resulting size keeps particles from rising high, causes them to settle out over large areas as the radioactive cloud moves with the wind

## NUCLEAR EXPLOSIONS: How fallout hazards develop

A nuclear explosion vents about 90% of its total energy immediately — in initial radiation, heat, and blast. The other 10% shows up afterward, mainly as radiation from fission products that rise with the mushroom cloud. Sooner or later, they descend to earth as *fallout*.

Fallout has its origin in the fission chain reaction that triggers the nuclear blast. This forms more than 200 different radioactive isotopes, which begin at once to *decay*, each at its own rate. Some decay almost completely in a matter of minutes, others so slowly that years later they are only slightly less radioactive. The differences in decay rate are a crucial factor in determining the hazards of fallout, and also in distinguishing between the two types of fallout — global and local.

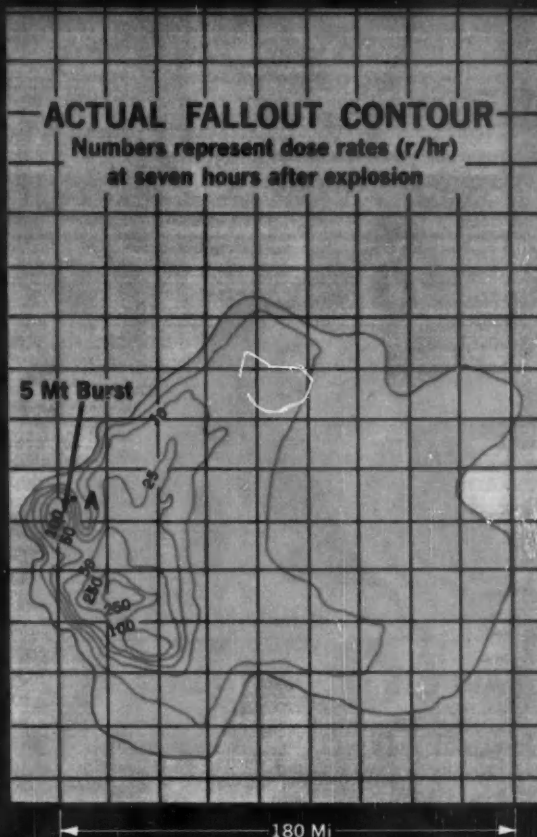
**Global fallout** is the type that has resulted from weapons tests already conducted, most of them air bursts (Fig. 1, p. 4). Fission products formed by such a burst first vaporize, then condense as extremely fine particles that rise into the stratosphere and travel with upper-level winds for long periods of time. Meanwhile, decay eliminates all but the long-lived isotopes, such as the much-discussed strontium-90. When the particles do drift down to earth,

they are widely distributed. So they raise the radiation level at any given point only minutely.

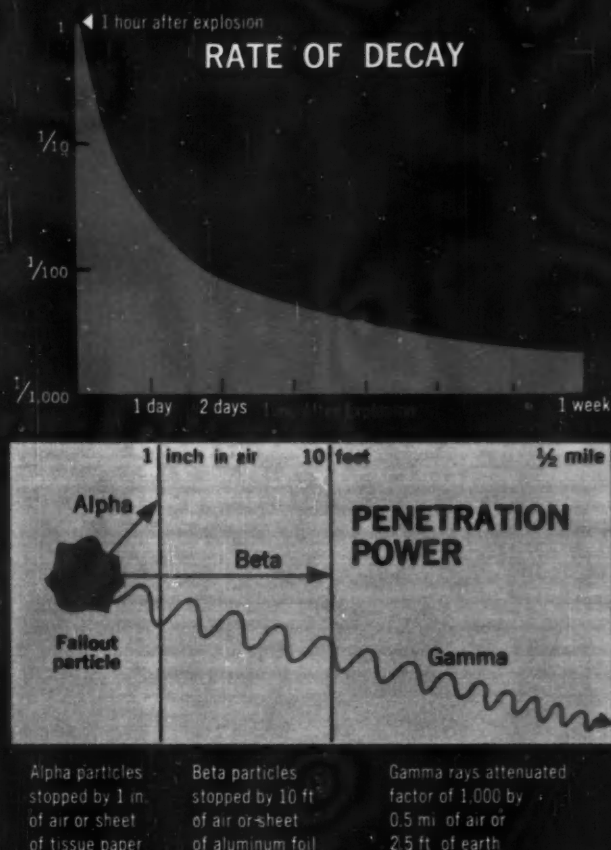
Such increases in radiation levels are considered to produce genetic effects. And strontium-90, moving from the earth's surface to plants and to food, can be selectively absorbed by the human body to cause bone cancer. Because these are all long-range effects, the impact of global fallout from nuclear tests is widely debated and will be truly known only in the future, when sufficient statistical data have been accumulated and analyzed.

**Local fallout** is much quicker to take effect — and much more dangerous. This type of fallout results from surface bursts, which would probably be part of a nuclear attack. Fission products from the explosion agglomerate with larger particles of debris (Fig. 4, above) and roughly 80% of them settle to earth in a matter of hours. Heavier particles descend in the first hour or so; lighter ones take several hours or more and winds carry them over hundreds of square miles. The major and immediate danger of this local fallout is radiation from these particles as they sift down over land and buildings.

The other 20% of the fission products from a surface



5. Theoretical pattern of fallout distribution at ground level appears at base of diagram on facing page. In contrast to this cigar-shaped pattern, actual distribution may be highly irregular, as illustrated above. Note particularly the several local "hot spots" and the fact that radiation intensities do not always fall off downwind



6. Radiation from fallout particles decays rapidly at the beginning, as shown in upper curve. This radiation takes three forms: Alpha and beta radiations consist of atomic particles that do not travel far, can be stopped easily. Gamma radiations are true rays, like X-rays. They can travel relatively far and they have great penetrating power

burst go into the stratosphere and become global, or worldwide, fallout. Because fission products are created in direct proportion to the amount of material exploded, a nuclear attack involving thousands of megatons would produce much more global fallout than has resulted from all the weapons tests so far.

Theoretical calculations to determine the distribution of local fallout usually assume that the wind blows in just one direction at 15 mph. Under such conditions, radioactive fallout will tend to settle in a cigar-shaped pattern (Fig. 4, bottom), with radiation intensity diminishing in the downwind direction and toward the outside edges.

In practice, however, winds at different altitudes move in different directions at different speeds. So actual patterns of fallout tend to be highly irregular (Fig. 5). This means that it isn't safe to use reports of general radiation levels as an estimate of hazards in your area. The only sure answer is to measure radiation locally.

**How to measure.** Fallout particles emit three kinds of radiation (Fig. 6), but only one — *gamma* radiation — is of major importance. Gamma radiation is like X-rays and you gauge exposure, or the *dose*, in the same units — *roentgens*. To measure the dose *rate* or radiation intensity, you use roentgens per hour (r/hr).

An instrument called a *dosimeter* will show the radiation dose to which you have been exposed. One common type,

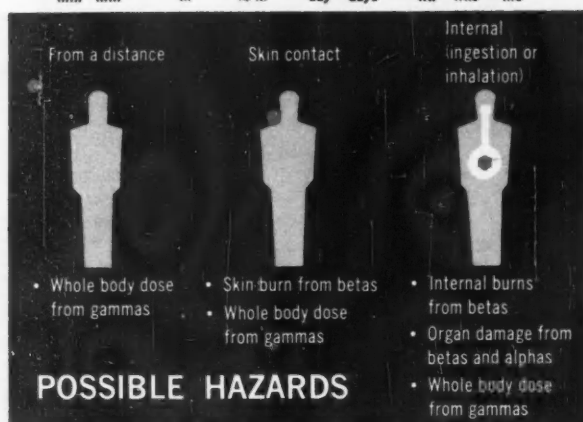
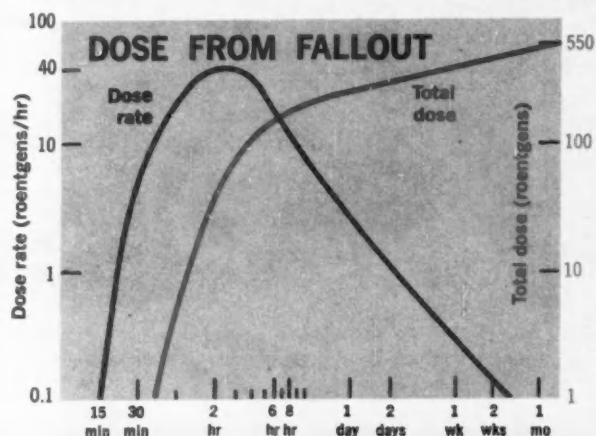
designed to be worn, is shaped like a fountain pen. Dosimeters of this sort usually record accumulated radiation up to about 600 r. In addition to keeping track of the total dose you have accumulated, you should also know the rate at which radiation is being received (r/hr). This can be crudely done with a dosimeter, by noting the increase in total dose over a period of time. For greater convenience and accuracy, a similar pen-shaped device is calibrated to read the rate up to 100 r/hr.

More elaborate portable *ratemeters* are on the market to indicate radiation intensities up to 500 r/hr — although at such high levels hand monitoring is dangerous. For more safety, you can install a stationary ratemeter — capable of registering levels of 1000 r/hr or more — and hook it up for reading in a protected location, such as a group shelter. To use the more elaborate instruments properly, operators would need a few hours of special training.

**Speeds of decay.** In appearance, fallout particles have a glassy surface. They range in color from white to black, and in size from clearly visible "sand" to barely visible powder (several thousand *microns* down to about 20).

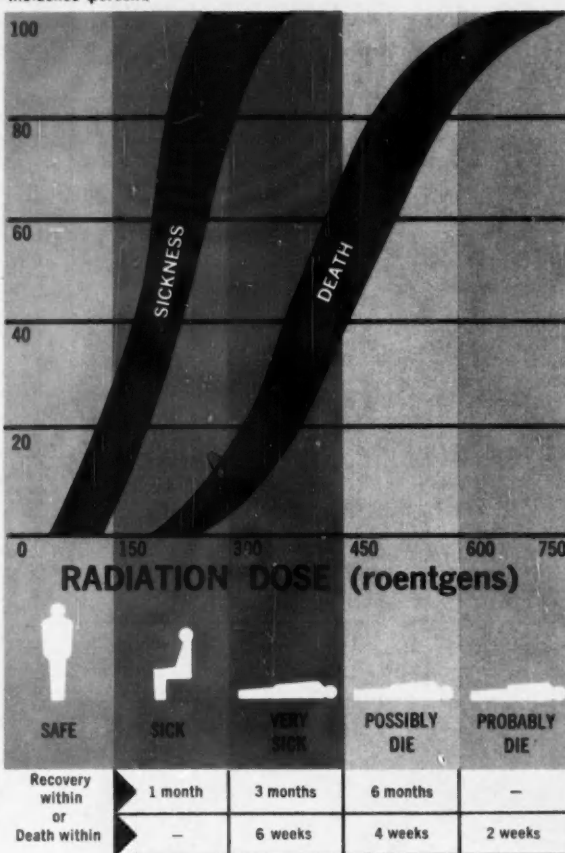
In any group of fallout particles, there will be a wide variety of isotopes, each with a different decay rate. For mixed fission products, the radiation level starts high but drops quickly (Fig. 7), as the isotopes with rapid decay rates spend themselves. An easy rule of thumb is that for





7. Radioactive fallout particles (lower diagram) can injure from a distance, on skin contact, or internally. Upper diagram shows whole-body gamma dose received by an unsheltered person at point A, Fig. 5. Dose rate reaches a peak when fallout is complete, then decreases as radioactivity decays. In contrast, cumulative dose continues to rise

Incidence (percent)



8. Effects of whole-body radiation doses can only be expressed statistically. Curves show percentage incidence of sickness and death in a group of exposed persons, for doses accumulated in a few days. Effects prove less severe if accumulated over weeks or months. As indicated at bottom, radiation sickness is usually a drawn-out process

each increase in time by a factor of seven, the radiation level decreases by a factor of ten: Seven hours after a burst, radiation level will be 10% of the level in the first hour.

In practice, however, it's not quite so simple. The first fallout might not arrive for 15 minutes or more after the explosion. But then fallout might keep coming for a time, and more than offset the decay that was occurring. As fallout slackened off, however, decay would begin to push radiation levels down, and after all fallout had arrived, the "rule of seven" would apply with reasonable accuracy for several months. So the rate of change in radiation would look like the humped curve in Fig. 7. But the dose accumulated by an exposed person would continue to increase, although more slowly after fallout has stopped coming down and the peak of the rate curve has been passed.

**Radiation hazards** stem from the fallout particles themselves. The air through which fallout passes, and the surfaces on which it settles, do not themselves become radioactive. Remove the particles and there is no danger.

Alpha and beta radiations from fallout particles penetrate such a short range that they are dangerous only if you cannot avoid inhaling, ingesting, or coming into skin contact with them. Gamma radiation is more perilous, however. It can be effective a considerable distance from the particle and has great penetrating power, hence ranks as a major hazard. An hour after a burst, the accumulated fall-

out on a 30x40-ft lawn — measuring at most 1/10 inch deep — might subject a person standing in the center to a dose rate as high as 1000 r/hr.

Effects of radiation on humans depend on such factors as age and general health. But statistical projections (Fig. 8) show that some people would not survive a dose of 300 r received over, say, 24 hours, while a few others would recover from twice this dose. Recent studies suggest that it is possible to survive even greater total doses accumulated in small units over long periods of time.

Radiation causes sickness primarily by damaging the blood-manufacturing centers in the bone marrow and lymph glands. In early stages it is usually accompanied by nausea, diarrhea, general malaise. These symptoms usually appear during the first day. Loss of hair, and skin ulcers, may follow in more severe cases. There is no specific treatment, but antibiotics and blood transfusions may help. Recovery is slow, involving weeks or months (Fig. 8). The sickness is not communicable.

For more details, consult "Effects of Nuclear Weapons" (\$2) and "Comparative Nuclear Effects of Biomedical Interest" (CEX58.8) (\$1), both published by the Atomic Energy Commission and for sale by Superintendent of Documents, Washington 25, D. C.

There is also a wealth of information in the record of hearings conducted by the Joint Committee on Atomic Energy (June 1959) and the Committee on Government Operations (August 1961).



# SURVIVAL AND RECOVERY:

## Why industry needs to plan now: how to go about it

What can business and industry do to prepare for the possibility of nuclear attack?

If your office or plant suffers a direct hit, obviously the answer is nothing. But the likelihood is that, even in a massive assault, the degrees of destruction would vary (pages 2 and 3). So you would have some chance to survive and to recover.

**What plans should you make?** As an executive, you are responsible for seeing that your company continues to exist and to function. In the narrowest sense, this responsibility is directly to the stockholders—the owners. More broadly, you have a responsibility to your employees, their families, the community, and the nation. Your company's organization and resources could be vital in coping with the crisis an attack would bring; the services it performs could be equally essential.

In the ordinary course of business, you plan some form of insurance to protect your company against a variety of risks—fire, windstorm, and so on. A large-scale nuclear attack is a risk that has never become reality. But it differs only in magnitude from the risks you routinely take into account. It is oversimplifying only slightly to say that you can apply the principles you use in preparing for other risks.

**Seeking a balance.** In building a conventional insurance program, you would try to assess the risk as realistically as possible—the degrees of damage that might be inflicted, how likely you are to suffer each degree of damage, how much it would cost to buy different amounts of protection. From these calculations, you would then strike some sort of balance, to give you the most protection possible for the money you can spend.

How would this approach apply, for example, to protecting your company's personnel from the effects of a nuclear attack?

You can't do much to protect against a direct hit, of course. But with nuclear attack, as with other risks, you don't assume that total loss is certain. The best estimates suggest that the most widespread danger will be from fallout. Second in order of probability comes fire; last is the combination of fire and heavy blast damage.

You must consider costs as well as probabilities. In general, the closer you might be to the target, the more it would cost to provide physical protection.

Balancing these two factors, it seems relatively easy to justify steps for protection against fallout.

For a minimum investment, you can achieve some measure of protection against the most likely hazard.

But don't stop there: For comparatively little more money, you may be able to buy some degree of protection against fire and blast. It depends on your situation, of course; to find the most practical answer, you must weigh the increasing costs of greater protection against the decreasing scale of damage probabilities.

Plans such as this for protecting personnel are only part of the over-all thinking that should go into the effort to survive a nuclear attack—and recover. Ideally, you should consider every element of your company's operations—such matters as preserving its framework of organization, its assets of all kinds and the records that prove ownership, its productive knowhow. And, when new facilities are planned, you should consider the problems of survival under nuclear attack in their location and design.

**Guidelines.** To draw up an effective plan, you might think broadly along these lines:

- The plan should start with top management—and top management should give it continuing support. This means launching the preparations with a meeting of directors or key officers, assigning the planning job to responsible people, informing employees of the policy over the chief executive's signature.
- The plan should be firm. In other words, it should not ebb and flow with the tides of international tensions, as some past planning has done.
- At the same time, the plan should be frequently reviewed to keep it in tune with changing conditions. New weapons, for example, might make your previous preparations obsolete.
- The plan should suit the community. You should coordinate it with plans of local government and neighboring industries. You should also consider what to do about employees' families and nearby residents. But, in most cases, you probably shouldn't count on civil defense authorities to solve all your problems for you.
- The plan should be suited to your company—its own resources, problems, type of operations. Some companies have found that streamlined procedures devised for the emergency plan can be applied to make everyday operations more efficient.

These, in broad outline, are some of the goals to aim for in preparing a plan for your company. More details on how to plan follow.

## SURVIVAL COORDINATOR

In a typical company's organization for survival, this would be the key man, directing, with top-management support, a Plant Survival Advisory Committee composed of the heads of the functions outlined (right). He would probably be chosen from upper management, since he must be well able to plan, organize, and delegate authority. He must believe in the importance of the job.

His first task would be to master the fundamentals of the assignment, by reading and special training. Then he would select top aides—who may now be heading up departments related to survival functions.

Broadly, the coordinator must plan the complete program for survival, help organize each of the functions, spell out responsibilities, designate shelter areas in existing buildings or provide for them in new ones, set up an emergency headquarters.

Other jobs would include linking the company's program with other community plans, arranging mutual aid, spotting vulnerable points in the utilities and process areas, preparing a survival manual for employees.

Periodically, the coordinator must report to top management on the company's readiness to survive an attack and on progress and shortcomings of the program to date.

The coordinator must always be alert to keep training and drills from slipping into routine. He should groom an assistant to step into his shoes. Finally, his compensation should reflect his importance.

## ENGINEERING

Members of the company's engineering staff would form the nucleus of the survival engineering group. Its job: to design shelter areas, perhaps with consultants; to equip shelters with utilities—emergency generator, water, light, heat or cooling, ventilation and air filtration, sanitation; and to operate and maintain equipment in shelters.

Sanitation in shelters would be a major problem that engineers must carefully think through in all aspects—toilet facilities, garbage, housecleaning, burial of the dead.

Engineers would help the communications group decide what equipment is needed, then help install and maintain it.

They would also work with the radiological team on such matters as monitoring equipment, building and plant design features to make decontamination easier, radiological control of decontamination and plant repair procedures.

When an alert sounds, engineers must be ready to shut down the plant—and to reduce the risk that the halt in production might cause fire, explosion, or escape of dangerous fumes. Fuel lines should be closed, most circuit breakers tripped in main substation. However, it would be wise to use regular sources for electricity and fuel in shelters as long as they were available, to lessen the load-time on emergency sources.

Engineers must be prepared to make some repairs to shelters—from blast or fire damage, say—and to the plant after attack.

## SHELTER MANAGEMENT

The team charged with shelter management would cope with all the problems of sustaining life in close quarters cut off from outside. Key men would probably come from the personnel department, with help from specialists in other areas. They would face problems such as:

- **Mass feeding.** The team would decide whether to use austerity rations, canned or dried, or a more nearly normal diet prepared in a shelter kitchen. It would also decide how much food to stock.

- **Water.** Questions would include how much would be needed, how to dispense.

- **Sleeping accommodations.** The program should set up a scheme for rotation; some people sleeping, others eating, etc.

- **Assigning chores.** This would keep people busy, shelter operating smoothly.

- **Installing lockers.** In these, employees could store personal needs in advance.

- **Stocking supplies.** The list would include reading and recreational materials, clothing, blankets, and so on.

To help bolster morale, personnel staffers should be able to draw on employees with special talents—excellent military records, entertainment ability, religious leadership.

The shelter management team would carry out the plan—if any—for accommodating employees' families in the shelter. It would work with the transportation team to evacuate shelters if necessary. And it would handle the many human problems.

# THE SURVIVAL PLAN: How to set up the organization

Once your company decides to plan a survival program, the first step would be to appoint a coordinator, or director. Then management must work with him to form the organization he would head.

**The key areas** in such an organization are outlined above. To fit your own operation, it may be possible to eliminate or combine some of the areas; on the other hand, you might have others to add.

At the outset of planning, it would be wise to consider enrolling key personnel in the Office of Civil Defense Staff College at Battle Creek, Mich., for training in the problems they will face.

In developing your program, you can profit from a mutual-aid plan. Besides arranging to assist neighboring companies and the community in an actual emergency, you can exchange study results and balance one company's assets against another's liabilities—one may have abundant shelter space, another portable self-powered generating equipment, a third skilled disaster teams, a fourth large food supplies.

One of the first problems in your plant would be the attack warning system. Your internal system should be

hooked up to receive the national alert instantly. Several techniques are under study for a nationwide alert; closest to reality is NEAR—for National Emergency Alarm Repeater—which uses existing electric power lines. Using a high-frequency signal, NEAR would reach about 95% of U.S. buildings within one minute. After hearing signal, you would turn on a radio for more information. NEAR units—expected to be available at low prices—could be plugged into any 120-v outlet.

The alarm in your plant should trigger production shutdown, and the moving of people to shelters.

Another immediate concern would be surveying how vulnerable the plant is to damage from attack. You should look, for example, for combustible materials that might easily be ignited, for large glassed areas that could be hit by blast, for narrow entrances or passages that could hinder the movement to shelters. You should also take note of points in the production process where damage or loss might cause major, long-time shutdowns.

**Participation.** Over-all, the urgent need in your planning would be to train personnel as quickly as possible, prepare them to be self-sufficient for some time after attack.

## HEALTH

Looking after health problems would be the job of the plant physician, aided by his nursing staff and a special team trained in first aid and emergency medical care. Don't expect outside help until well after the attack.

Each shelter should contain at least one health station, stocked with drugs, oxygen, and supplies for treating the effects of possible chemical and biological warfare. There should be plans for meeting psychological problems.

With the shelter management team, the health director would plan for moving casualties to treatment stations and identifying them. This could be simplified by use of "dog tags."

## FIRE AND RESCUE

A trained firefighter should guide this team. During attack, it would have two jobs—to control fire and to clear damage for health teams.

In the planning phase, this team would pinpoint plant areas where fire danger is greatest, such as stockpiles of flammable materials. If hazard can't be eliminated, engineering group may install sprinklers or other measures.

For effective rescue work, the team should have detailed knowledge of the plant's structure and production processes. This group would probably be last to enter shelters—and should be prepared to leave them for short, controlled periods to cope with emergencies.

## RADIOLOGICAL

This vital team—most likely selected from the company's engineering staff—would focus on radiation problems. Among other things, it would:

- Estimate the protection from fallout that is available in various shelter areas.
- Buy radiation measuring instruments.
- Monitor radiation levels and be on alert for agents of chemical and biological warfare.
- Plot fallout patterns in surrounding areas.
- Record individual dosages of radiation.
- Analyze food and water to assess contamination—and supervise its removal.
- Working with the engineers, this group should plan, and supervise, decontamination.

## COMMUNICATIONS

The goals of this group would be to link the company with the nationwide alert program, set up a plant warning system; provide for emergency telephone, telegraph, radio equipment; staff a communications center connecting all plant shelters; keep in touch with local civil-defense authorities and the community if possible, help employees contact families.

The team might also publish some version of the company newspaper in shelters, perhaps in mimeographed form. The shelter communications center should include a public-address system; it might sometimes be advisable to hook Codelrad broadcasts into this system.

## SECURITY

Built around the company's present security force, this group would be an in-plant police team. The chief could recruit as aides employees with military or similar qualifications.

The men would need training in maintaining order, handling crowds, and coping with panic, and they should be prepared to prevent looting. They would map emergency routes to shelters, both inside and outside plant grounds.

At all times, this group should be on the alert for possible espionage and sabotage. It would establish liaison with state and local police and assist them in carrying out any emergency plans for community security.

## TRANSPORTATION

Trucks and manpower would be needed before and after an attack. The core of this program would be a fleet of trucks well equipped for radiological monitoring, first aid, carrying casualties and supplies, emergency repair of utilities. These vehicles would link the company with others participating in a mutual-aid plan.

In developing emergency transportation plans, this group should tie in closely with local civil-defense authorities and should coordinate its efforts with those of other plants in area.

During the early period of recovery, bulldozers—possibly shielded—would push contaminated earth and debris away from the plant.

To be most effective, the company's plan should call for training all employees to take part in some way. Acceptance by employees could be encouraged by consistent management support, by constant efforts to keep the program vital and interesting, by regular checks of the coordinator's staff, by quick dissemination of the latest information on civil defense and community programs, by enlisting support from unions and community groups.

The problem of keeping a disaster team efficient—perhaps for years—challenges the resources of the most imaginative company officer.

To complicate the problem, the planning should include decisions on what to do about protecting off-duty employees, families, and such people as visitors and contractors who happen to be at the plant when attack strikes. If your community is one where families live fairly close to the plant, you might think seriously about accommodating them in the plant shelter, as part of your broad responsibility to employees and the community.

**Sustaining morale.** In setting up a shelter, you must consider more than engineering (pages 12-13): One concern—largely unpredictable—is morale and discipline. Sweden has tried to ease the problem by using color and design extensively to make shelters brighter. Morale can also be influenced by such factors as the amount of space available to the individual; providing routines and chores,

entertainment, spiritual guidance; keeping families together; and taking action in cases of hysteria and panic.

It would probably be best to leave discipline to supervisors and others accustomed to exercise authority. With training, the plant security force could help the shelter-management group to direct routines, and the medical team to handle shock and panic victims.

You should make generous provision for food, clothing, and blankets in the shelter. For the food planner, a great deal of information is already available. Perhaps the basic study is "Food Stockpiling for Emergency Shelters," published by the Food & Materials Div. of the U.S. Dept. of Agriculture's Commodity Stabilization Service. OCD and USDA offer many other pamphlets on the subject.

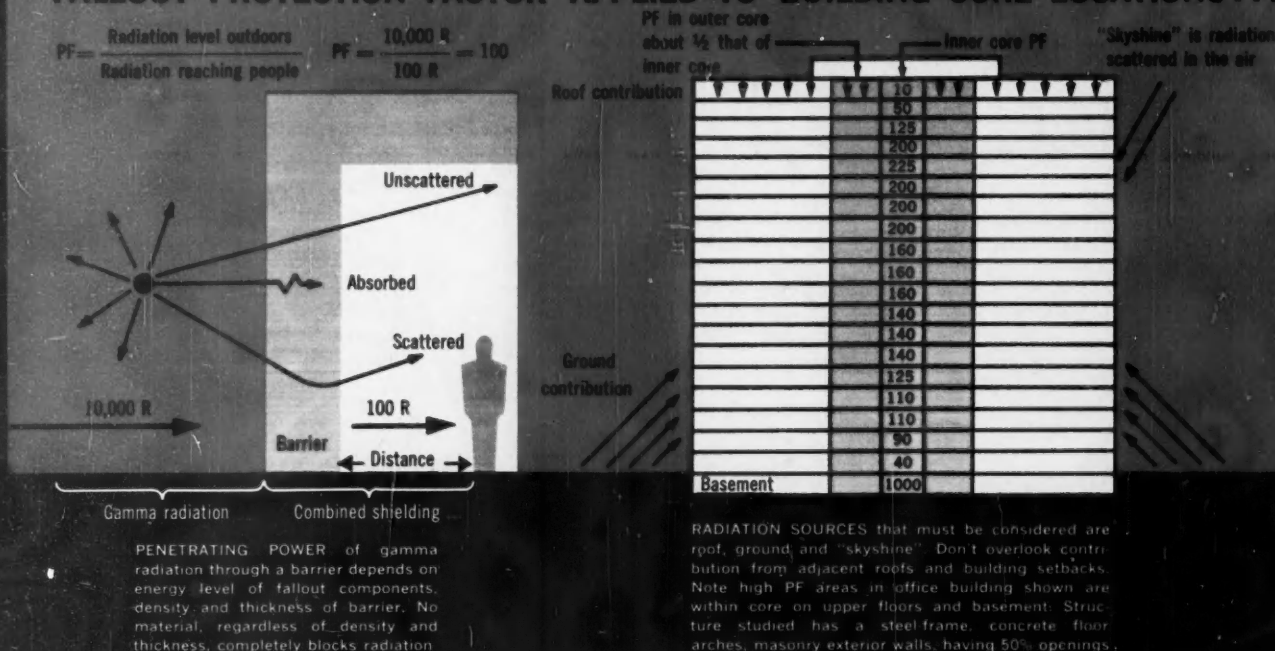
Another question would be how to distribute food in the shelter. If the company cafeteria can be moved into the shelter area, mass feeding is probably the answer—although cooking in the shelter would require some source of heat. Or you might decide on stocking individual rations that supply minimum requirements in concentrated form. A variety of such subsistence foods is already available and on the market.

Study of your plant and employees would probably reveal other special needs.

Engineering points to consider in planning a shelter are discussed on the following two pages.



## FALLOUT PROTECTION FACTOR APPLIED TO BUILDING CORE LOCATIONS...



## THE SURVIVAL PLAN: What about physical protection?

As you set up a company organization for survival, a prime ingredient in the plan would be finding the best way to protect your people against the effects of nuclear explosion — primarily against radioactive fallout, but also as much as possible against blast and fire.

After an attack, fallout would threaten you from three directions (drawing, right, above). Some would accumulate on the ground around your plant, and some on rooftops. In addition, building walls would feel the radiation scattered by the air, sometimes called "skyshine".

**Key to protection** from fallout is to place a physical barrier between it and you—steel, concrete, earth, water, or wood. How well a material screens you depends on its density and thickness. To do an equal job of absorbing radiation, you would need thicknesses of 0.3-in. of lead, 0.7-in. of steel, 2.2-in. of concrete, 3.3-in. of earth, 4.8-in. of water, and 8.8-in. of wood. These figures represent a quantity called the *half-value layer thickness* or HVL.

The HVL figure shows in inches how much thickness of each material is necessary to stop half the gamma radiation outside from penetrating the barrier. Each HVL thickness you add to the first reduces what comes through another 50%. Two HVL thicknesses side by side let in only 25% of the total gamma radiation outside; adding a third HVL thickness lets in but 12½%, and so on. This is true as a general concept, results vary with specific conditions.

Use a material's HVL figure to approximate how effectively a barrier will soak up radiation energy. But the practical value of the barrier — its *protection factor*, or PF — depends on the location of the fallout in respect to the barrier and on the area of fallout.

A building's geometry plays an important role in protection against fallout, too. For example, protection factors would differ in two tall buildings of the same height and construction if one covers a larger area than the other, neglecting roof contribution. At the center of the first floor, the PF would be higher in the structure with the larger base simply because at that point you would be farther from the outside ground radiation. Likewise, the PF would differ at first floor center of two buildings with similar base areas and construction but varying heights. Neglecting ground contribution, the taller building would offer more protection because radiation would have farther to go from roof to first floor. Of course, in such calculations you must also consider the contribution from fallout on roofs of adjacent buildings.

What is a minimum acceptable protection factor? There is no standard figure, since it is impossible to predict the radiation level to which you might be exposed. One commonly suggested minimum is 100.

For many structures it may be practical to adopt the "core" shelter plan—in which you would set aside one area of a shelter offering highest possible protection, perhaps at the well-protected center. People would be crowded into this core, however uncomfortably, during the hours of peak fallout, then rotated between the core and shelter areas with lower protection factors. Or the rotating schedule might be used from the beginning of the shelter stay.

**Spotting safe areas.** A survey of your building should reveal areas that would offer some fallout protection without radical change. The choice would quickly narrow to areas with walls and ceilings of thick, high-density mate-

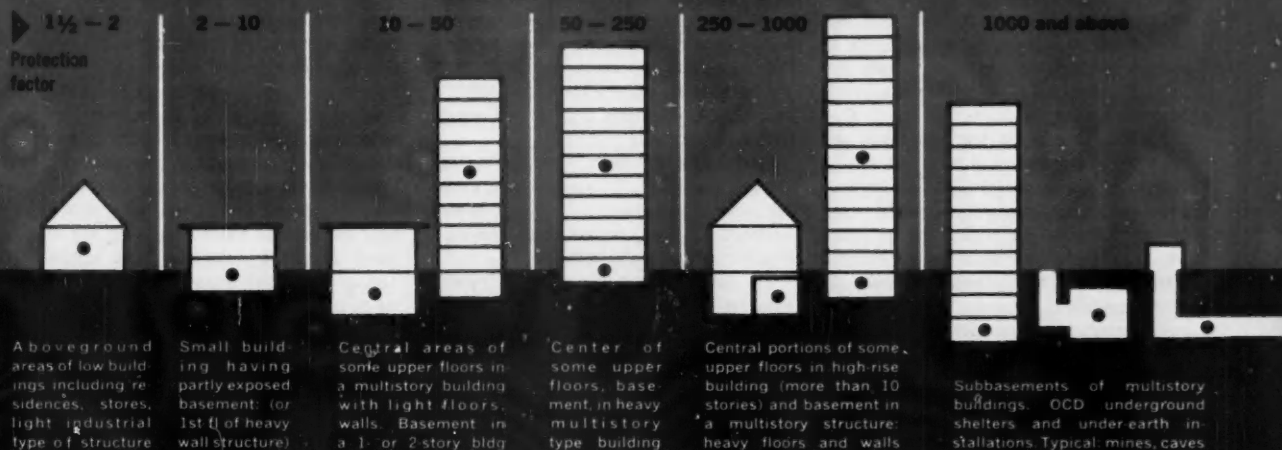


## TYPICAL PLANTS, COMMERCIAL BUILDINGS AND UNDERGROUND SHELTERS

**LIKELY SHELTER LOCATIONS** in any building are those offering highest protection factors. Illustration below gives a general idea of the relative protection found in common structures. Use it as a guide only, to estimate protection against fallout. The PF values listed may be conservative, being based on isolated structures.

Your shelter survey starts with knowing construction detail of all your buildings, number of people normally on the property, placement of utilities. Roughly estimate total group the shelter can handle by allowing 15 sq ft of gross floor area per occupant. Gross area includes columns, some fixed equipment, storage for shelter supplies. Net area per person should be 10 sq ft. Shelter occupancy time may be limited by room volume rather than area, particularly in absence of mechanical ventilation. Natural ventilation from interior stairways, shafts, extends stay. Fresh air minimum: 3 cfm per person.

ment of utilities. Roughly estimate total group the shelter can handle by allowing 15 sq ft of gross floor area per occupant. Gross area includes columns, some fixed equipment, storage for shelter supplies. Net area per person should be 10 sq ft. Shelter occupancy time may be limited by room volume rather than area, particularly in absence of mechanical ventilation. Natural ventilation from interior stairways, shafts, extends stay. Fresh air minimum: 3 cfm per person.



rial and few windows and doors. Some degree of safety would be available, for example, in sub-basements, basements, centers of masonry buildings. You could thicken existing walls if necessary, and concrete baffles could be placed a few feet or so in front of windows and doors to screen out radiation while leaving them in service. To further guard, primarily against roof fallout, you could erect false ceilings using supported concrete planks.

For detailed help on how to survey structures for fallout protection, consult Office of Civil Defense publication NP-10-2, *Guide for Architects and Engineers*.

**Shelters from scratch.** If adequate shelter areas cannot be created in present buildings, you would probably construct new ones designed primarily as shelters. Such a structure could be engineered to withstand some blast and fire as well as fallout. It could take one of several forms; there are many designs for combination blast and fallout shelters. Some are all concrete; others use a multiplate corrugated-steel arch set on a concrete slab. Latter shelter could be built above ground, with an earth mound completely covering it; partly underground with an earth cover, or entirely underground. An underground shelter could be designed as the sub-basement for a building to rise on this foundation later. Whatever the choice, you should try to give the shelter some peacetime use—perhaps as a plant cafeteria or recreation center.

**Typical group shelter** suggested by the Atomic Energy Commission (in its booklet CEX-58.7) would accommodate 100 persons with a protection factor of 10,000 against fallout. This shelter would withstand blast pressure of 35 psi—which should make it safe against blast effects of a 10-mt weapon to within a few miles of ground zero. Tests have shown it could withstand a firestorm.

For any shelter, you must plan utility supplies. Water would be the first need; the best bet would be to store it

in a closed system, unless you have a dependable well. Figure on a minimum of 2 quarts of water a day per person, another 2 quarts for washing. If you draw on public water supplies that might become contaminated or polluted, you should install filters for insoluble isotopes, ion-exchange for soluble ones, plus chemical treatment. You would also have to take account of buildup of radiation levels in ion exchanger and filters.

**To provide ventilation,** you could choose a variety of systems. For most fallout shelters, a simple mechanical ventilation system with filters to remove fallout particles should suffice.

A more elaborate system offers fully automatic, thermostatically controlled air conditioning for underground blast shelters. It draws 100% fresh air from outside, filters and conditions it to proper temperature and humidity, and removes used air. With an air conditioning system that removes carbon dioxide and adds oxygen, it would be possible to shut the shelter off from outside for 24 hours.

At the other extreme, in some situations you could use simple natural-draft ventilation.

**Electric supply.** You must also supply electric power to the shelter for lighting, ventilating equipment, some cooking, and possibly for sewage pumping. The answer would be an engine-driven generator and a stockpile of fuel. You should also install a separate electrical feeder from your main substation to shelter areas, so that you could use the normal power as long as it is available.

For sewage, you should include in the plans a collector tank with an ejector pump leading to a cesspool.

**Decontamination facilities,** for people who must come into the shelter after being exposed to fallout, should be installed near entrances. Recommended procedure includes removal and safe disposal of contaminated clothing, followed by a shower before donning fresh clothes.

## The post-attack environment: What problems will it present?

In its day-by-day operations, your company depends on all sorts of links with the rest of the economy. It uses the services of the transportation, communications, utility, and banking systems. It relies—directly or indirectly—on outside sources for materials, fuel, food, and other supplies. It looks to the community to provide such essentials as water, sewage disposal, highways and other public works, health services, and the like.

Nuclear attack would tear that fabric and leave behind a patchwork of areas with varying degrees of damage (pages 2 and 3). For your planning, you need to visualize how this would hit your company—and what steps are under way to soften the blow and to restore services after an attack. It is impossible to predict post-attack conditions precisely, of course, and many present plans are tentative and subject to change. But here's a current summary of the probable situation in vital areas:

**TRANSPORTATION** — for moving food, fuel, medical supplies, material, and personnel — would be the service perhaps most essential to recovery. Railroads, with their fixed routes, are likely to be hardest hit. With adequate

fuel supplies, trucks and other flexible forms of transport—such as aircraft—could operate by bypassing damaged areas.

Unfortunately, planning in trucking is confused by divided authority. One federal agency would have emergency control over carriers, another over the streets and highways on which they move. And this control seems to apply only to interstate carriers; there is no authority to coordinate intrastate truckers and private company fleets.

Present plans call for carriers to take these steps in emergency: (1) Warehouse all goods, sell perishables if possible. (2) Obtain permits—from at least one, perhaps three agencies—to start hauling priority traffic.

The industry has begun to form trucking mobilization groups that may become the core of a broad emergency transport system.

**COMMUNICATIONS** has several vulnerable points — among them the network of exposed lines and the lack of protection for radio and TV personnel and equipment. In addition, high-altitude explosion of large nuclear weapons could cause temporary radio blackouts.

Major common carriers are working to

"harden" lines and equipment and to bypass likely target areas with self-contained underground communications channels. They also have repair crews, fully equipped and trained for disaster, spotted at widely dispersed points. Some radio and TV stations have launched protective measures. And there are plans for coordinating commercial and amateur radio operations to close gaps in coverage after an attack.

During the early period of recovery, communications facilities would probably be available only for highest priority messages.

**UTILITIES** are in danger because many power generating plants are concentrated geographically and because transmission lines are exposed. Suggested remedies include building multiple and interconnected lines, and dispersing switchyards. Many companies are studying ways to protect personnel and equipment, constructing alternate emergency control centers. Utilities have a major asset in personnel trained and experienced in dealing with disaster.

**MONEY AND CREDIT** is one area where plans are ready now. The Federal Reserve System has led other government agencies in preparing for the problems of recovery. It has made

## THE RECOVERY PLAN: What needs to be included in it?

Planning for recovery from a nuclear attack takes an almost staggering effort of imagination. You must try to visualize the shattering of our complex civilization, the breaking of the many links that tie our economy together (above). If you are to plan at all, somehow you must picture the problems attack would create for your company and its people — and prepare now to cope with them.

Problems of the early post-attack period would be basically similar to the problems of survival. So they could be tackled best by the same organization—which would be in control not only during an attack but in the weeks after.

**After the assault**, trained workers should be able to foray briefly into plant areas that have been damaged, or contaminated by fallout. They should work in relays, to expose each team member to minimum radiation. The purposes of such trips should be ranked by priority spelled out in your company's plan; at first, the goal should be only to take steps that would make shelter life safer.

Decontamination would be a major problem, particularly on roofs and on land surfaces around the plant. An automatic flushing system, draining to a safe distance, might help clean roofs; as mentioned earlier, a shielded bulldozer could scrape contaminated soil away from facilities. These chores must be under radiological controls.

A related job — subject to the same careful controls — would be removing debris from possible fire and blast

damage and making repairs. Here again, priority should go to steps that would yield the most immediate benefit.

You must assume that you would perforce be self-sufficient for some time after an attack. But you would try to link up as soon as possible with any interrupted utilities. You should be equipped to test your water supply for radioactivity and potability until notified that it is safe.

**Information needed.** You should plan early efforts to contact others in the community — the civil-defense organization, disaster-relief groups, neighboring plants that might offer—or need—mutual aid. In this immediate post-attack stage, there would be a desperate need for information. Employees would want to know what happened to their families, their homes, the community; you would need to know about local supplies of food, fuel, and other supplies, about casualties, about regulations to keep law and order.

In some nations with extensive civil-defense plans — Sweden, for one — martial law takes effect as soon as an attack warning sounds. U.S. plans thus far made public do not call for martial law — although it would seem possible. Instead, the approach has been to try to insure that local and state governments would continue to function. Federal agencies have already done a great deal toward specifying automatic lines of succession for officials, setting up alternate headquarters or hardening present sites, preserving essential records. All but five states have taken some legis-

# What are plans for restoring key segments of the U.S. economy?

lines of succession and authority clear. Member banks have been encouraged to store duplicate records in safe locations from which they could operate if necessary. More than two years' supply of Federal Reserve notes has been placed at strategic points around the U.S. The Fed itself has an emergency headquarters.

A check with the Fed and its member banks may greatly simplify your own plans for meeting emergency needs for money and credit.

**AGRICULTURE:** Food is not likely to be a critical problem early in the recovery, except for local shortages caused by transportation snarls. The grim probability: more food would survive than people.

Fallout does not harm food in cans or in non-porous bags and packages that remain closed. So most stored food would be usable, except in heavily damaged areas. Some of the standing crops that survive could be harvested and used after decontamination. Livestock killed by radiation would be edible if promptly dressed and refrigerated.

Food from current inventories and stockpiles would probably be sufficient to support the survivors while they slowly returned some

fallout-contaminated farmland to cultivation.

**PUBLIC WORKS** would present a variety of problems. According to most experts, water supply would not be a serious worry. Surface waters and open reservoirs would be contaminated by fallout, but most of this could be filtered out. Some fallout would be soluble, however, and this might require either waiting for radioactivity to decay enough for safe use, or installation of ion-exchange treatment in addition to usual treatment for potability.

Water distribution systems, sewers, and streets would suffer various degrees of damage. Removing debris would be a huge chore in areas damaged by fire and blast. OCD has briefed state and city public works agencies on their responsibilities in these jobs. Emergency equipment—including generators, pumps, water purifiers, and pipe—are already on hand at 24 spots around the country. To encourage states and cities to buy similar supplies, the federal government will put up matching funds to equip and train local personnel.

Any company registering equipment, personnel, and engineering talent with a central disaster-relief organization can obtain "Plan Bull-

dozer" from Associated General Contractors. The plan includes instructions for a cooperative program to clear debris quickly.

**HEALTH SERVICES** will present one of the gravest post-attack problems. Even with effective shelters, an attack would leave many people injured and sick. Physicians, nurses, hospitals would be lost—most heavily in the areas with most casualties. And in the aftermath of attack would come infections and disease.

The U.S. Dept. of Health, Education & Welfare has designed a basic package unit for an austere but effective 200-bed general hospital. Some 1900 of these units have been bought and placed in critical areas away from likely targets. Plans are under way to distribute another 750 units and to equip all of them with 30-day supplies of medical equipment and supplies. HEW is also responsible for stockpiling plasma, serums, essential drugs, supplies.

To offset a shortage of doctors and nurses at least partly, HEW is readying a program called "Medical Self-Help." This provides basic training in first aid and general medical treatment. The course will be given to civil defense groups and industrial disaster organizations.

lative steps along similar lines, although only a few have scored much progress.

Despite these steps, law and order could break down in some areas. So your company's plan should provide for handling such problems both inside and outside your plant. On the outside, your organization could help restore order in the community. This requires close integration of your group and local civil government.

**Long-term plan.** For the long-range recovery of your company, you face planning problems different from those of survival during and immediately after the attack. Logically, then, you should assign such planning to a separate group, usually drawn from top management. This committee's primary worry would be outlining steps to take, in advance, to preserve the company's organizational framework and the assets—tangible and intangible—on which it depends.

The bylaws of most companies tightly limit the board of directors—where it may meet, what constitutes a quorum, how new directors are elected, and so on. Such restrictions might make it legally impossible for the company to carry on if a massive disaster should incapacitate many directors, or resulting transportation snarls should prevent a quorum.

To correct this, your plan should include bylaw changes to permit surviving directors—or even a single director—

to fill vacancies without delay, pending a regular or special stockholders' meeting. You might also create an emergency management committee, empowered to act for the board of directors under specified conditions. Any such steps should be based on careful legal study. Some states have modified their laws to give you more flexibility—or plan to do so—but others have not. A good starting point for your program: the literature on corporate continuity published by the Office of Civil Defense, industry and trade associations, and other such groups.

As a next step, you should review all company functions in the light of probable conditions during the recovery. From this review, you would be able to pick the most essential jobs and allot them among the company's staff—with successors named for each post. This succession, too, may require bylaw changes.

For recovery, a company would need essential records to continue operating. Storing them safely would be the smallest problem; much more difficult is deciding which records are truly vital. Some executives recommend dividing them ruthlessly into three categories:

- **Vital records**—irreplaceable; of less value in reproduced form; necessary to recover monies promptly or to restore production, sales, and service.
- **Important records**—very expensive to reproduce, in dollars or time.
- **Useful records**—whose loss would be inconvenient, but could be replaced readily.

Records such as the following would probably qualify for safekeeping: property deeds and other proofs of ownership of assets; stockholder data; insurance certificates;

Reprints of this report are available at publisher's cost: Less than 100, 20¢ each; 100 or more, 15¢ each; 1000 or more, 10¢ each. Address all requests to "Operation Survival," P.O. Box 573, Times Square Station, New York 36, N. Y.



## FEDERAL AGENCIES AND CIVIL DEFENSE

By executive order (August 1, 1961), the President transferred basic responsibility for civil defense from the former Office of Civil Defense and Mobilization to the Department of Defense. With its remaining functions, OCDM was renamed Office of Emergency Planning.

Specifically, the Secretary of Defense is in charge of development and execution of a program to minimize the effects of attack, including informing and educating industry and the public in methods of survival. This includes a fallout shelter program, a warning and communications system, and a program to assist state and local governments in such post-attack community services as health and sanitation, maintenance of law and order, firefighting and control, debris clearance, traffic control, provision of water supplies.

The Director of the Office of Emergency Planning is responsible for planning continuity of state and local governments, the natural-disaster relief program, the defense mobilization program, the strategic and critical materials stockpiling program.

Previously established policy calls for making maximum use of

existing Federal departments. Typical civil-defense responsibilities that are assigned to other agencies include:

Dept of Agriculture: Food stockpiling, rural fire control, protection of vegetation and animals against radiological, chemical and biological hazards.

Dept. of Commerce: Restoring streets and highways; use of emergency shipping.

Federal Aviation Agency: Emergency use of civil air transport, civil airports and airways.

Dept of Health, Education, and Welfare: Medical stockpiling; care of refugees from attack, including location services.

Dept. of Interior: Emergency plans for power and petroleum.

Dept of Labor: Planning use of emergency manpower, except medical, in immediate post-attack period.

Post Office Dept: Registration of individuals and families.

Housing and Home Finance Agency: Emergency housing and community services in the post-attack period.

Interstate Commerce Commission: Plans for use of domestic service transportation in emergency.

patents, important engineering drawings and process data; records of employee pension funds and other such financial plans; important contracts, including union contracts. These would also have to be kept up to date, of course.

If you carry on business at several widely separated points, you should store duplicates of vital records at each location. You should also arrange for management personnel at each point to take control of company operations at other locations, if necessary. Plans should also be made for mutual aid between the several plants and offices.

In some cases, you should consider establishing alternate headquarters, with duplicate records and living quarters. This could give a one-plant company the advantages of a larger company with dispersed operations.

If an attack struck when employees were not at work, they would need to know where to report when conditions permitted. One answer would be to designate emergency centers, possibly in suburban homes of supervisors.

**Fiscal plans.** Your plan should set up emergency financial procedures. For example, you would probably need a simplified accounting system for use after attack. You would want funds quickly available for wage payments, advances to employees, and buying food and supplies. One solution might be to preprint checks of fixed denominations and distinctive design. They would be stored in a safe place and used only in emergency, with the signature of anyone of a list of management personnel.

Finally, you must try to prepare for restoring production in an emergency economy — probably with wage and price controls, government allocation of materials and manpower, and so on. Production would quite likely be geared to goods most useful for recovery.

You would want to analyze how your company would be suited to alternate lines of production, perhaps develop alternate sources of supply, and production techniques to make your operations as flexible as possible.

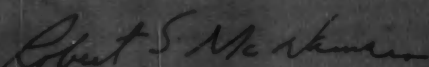
Copyright© 1962 McGraw-Hill Publishing Co., Inc. All rights reserved.

## THE TASK AHEAD

If our nation should suffer a large-scale nuclear attack, the measure of our ability to survive and recover will be the courage with which we appraise the dangers, and the vigor with which we act to prepare for them.

In such planning, business and industrial executives have a special stake and exceptional responsibilities. The organizations they direct not only provide the sinews of the economy on which recovery would depend, but can — and should — provide focal points of direction and leadership.

Some companies have already displayed commendable foresight and enterprise in preparing for the possibility — however unlikely — of nuclear war. But a big job remains to be done. I urge every responsible American executive to give these problems his immediate and earnest attention.



Robert S. McNamara  
Secretary of Defense





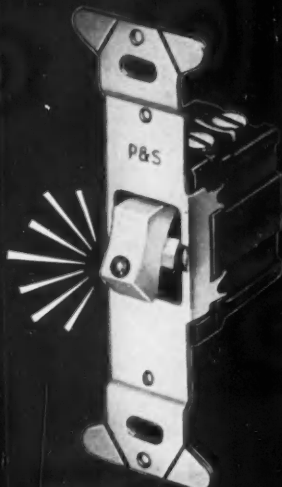
# NOW!

## 3 NEW P&S ROCKER-GLO SWITCHES!



No. 2211-SL

No. 2211-SL also available in strap type No. 2221-SL



No. 2221-SP

No. 2221-SP also available in Despard (interchangeable) type No. 2211-SP



No. 2225-S

No. 2225-S also available in Despard (interchangeable) type No. 2215-S

1

### LIGHTED HANDLE ROCKER-GLO

Pinpoints switch location in darkened rooms or hallways. Tiny, long-life neon lamp softly glows in OFF position only. Single pole or three-way. Rating: 15 Amperes, 120 Volts, A.C.

2

### Pilot Light HANDLE ROCKER-GLO

Instantly shows when appliances or lights are on. Tiny red plastic jewel in rocker button lights in ON position only. Single pole only. Rating: 15 Amperes, 120 Volts, A.C.

3

### REMOTE CONTROL ROCKER-GLO

Momentary contact, center "off" switch. Designed especially for low voltage remote control applications—controlling large banks of lighting, operating stage curtains, etc. Single pole, double throw. Rating: 10 Amperes, 48 Volts, A.C.

For more information write Dept. ECM 162



**PASS & SEYMOUR, INC.**  
**SYRACUSE 9, NEW YORK**

60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario



**WEIGHT LOSS DUE TO ATMOSPHERIC CORROSION**  
after 3100 days exposure.

<b>YOLOY STEEL</b>	<b>OPEN HEARTH</b>	<b>BESSEMER STEEL</b>
<b>3.70 LOSS</b>	<b>9.38 LOSS</b>	<b>18.29 LOSS</b>

**RESISTANCE TO SOIL CORROSION**  
13 Soils Ranging from 2.6 pH to 9.4 pH

	CARBON STEEL		YOLOY		WROUGHT IRON	
Time (Years)	Wt. Loss*	Penetration**	Wt. Loss*	Penetration**	Wt. Loss*	Penetration**
2	6.1	52	4.3	41	4.8	48
5.4	11.1	81	7.2	52	8.8	75
7.4	12.1	89	9.5	79	10.9	89
9.3	17.4	88	10.6	79	12.2	97
14.3	19.7	107	11.8	93	16.3	98

\* Wt. Loss, oz/ft<sup>2</sup>

\*\*Penetration—mils (Average Max.)

**SEA WATER IMMERSION TEST**

Material	Days In Test	Wt. Loss (Grams)	Corr. Rate		Pitting—Mils	
			Wdd	IPY	Max	Aug
Mild Steel	2162	1439	36	.007	Perf.	128
Hand Puddled Wrought Iron	2384	1401	32	.006	Perf.	115
Mechanically Puddled Wrought Iron	2384	1247	28	.006	139	80
Yoloy	3429	1616	25	.005	90	62

# YOLOY

**Exclusively from Youngstown—  
corrosion resistant steel  
conduit you can depend on**

Hang it in the air. Bury it in the ground. Sink it in the sea. Use Youngstown rigid Yoloy steel conduit in impossible places where corrosion eats other conduit away. Use it because Yoloy lasts.

This better, tougher, bendable copper-nickel alloy steel conduit has up to 6 times the corrosion resistance of carbon steel conduit. You can cut, bend, thread, work, install and fish it with ease.

High replacement costs demand a special conduit like Yoloy. Youngstown research created it. Electrical distributors, supplied from Youngstown stocks, will deliver it in the exact quantity, size and kind you need—wherever you need it: ½" to 6" in Hot Dip Galvanized, Black Enameled or EMT.

With Yoloy, you'll get the same uniform high quality that has made Youngstown Buckeye Conduit famous in the industry. Conduit you can depend on. U.L. approved. All from modern Youngstown—largest producer of rigid steel conduit in the world.



## Youngstown — growing force in steel

For information about Youngstown Yoloy Steel Conduit, write: Dept. 26B,  
The Youngstown Sheet and Tube Company, Youngstown, Ohio





## SOLA CONSTANT-WATTAGE FLUORESCENT BALLASTS

Specified for the Harris Trust and Savings Bank (Chicago) — these remarkably reliable SOLA two-lamp fluorescent ballasts! Here, in this specially tailored installation, heating and cooling are handled via the lighting troffers, an arrangement designed to assure Harris Trust and Savings Bank complete flexibility in placement of partition walls, with ample light and ventilation for all areas.

25,000 SOLA 40-watt ballasts are employed throughout the building. Records, after two years, show the kind of cost-saving reliability that built our business here at SOLA; 99.9% of these ballasts still are trouble-free, faithfully doing their job without attention.

Actually, it's not surprising. Records of SOLA ballasts prove that 99.86% surpass warranted performance! And SOLA constant-wattage design insures better striking with open-circuit RMS voltage well above minimum requirements . . . plus full rated lamp life through low lamp current crest factor.

It pays to specify SOLA every time. Write today for complete catalogs and prices.

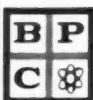
S-32-61



SOLA 40-w Rapid-Start ballast — the type employed in Benjamin Lumi-flo light-and-air troffers (left) throughout the new Harris Bank Bldg. shown below.



DIVISION OF BASIC  
PRODUCTS CORPORATION



SOLA ELECTRIC CO.  
1717 Busse Road  
Elk Grove Village, Ill.  
HEmpstead 9-2800  
IN CANADA, Sola-Basic  
Products Ltd., 377 Evans  
Ave., Toronto 18, Ontario



## Asbestos Cement Ducts Resist Salt Corrosion

**I**NSTALLING underground ducts in reclaimed tidal land involves numerous corrosion problems, a fact which can be verified by Coopman Electric, Clyde Bentley and Warnecke & Warnecke, the electrical contractor, consultant and engineering firm involved in a \$17½-million expansion program at Oakland, Calif., international airport. Scheduled for completion early next Spring, the airport is moving more than a mile out into San Francisco Bay in order to obtain a 10,000-ft runway with unobstructed over-water approaches at both ends. This has involved construction of a 12-ft-high 4½-mile dike which now encloses 1400 acres (14-million cubic yards) of reclaimed land consisting of fill dredged from the Bay and pumped to the construction site.

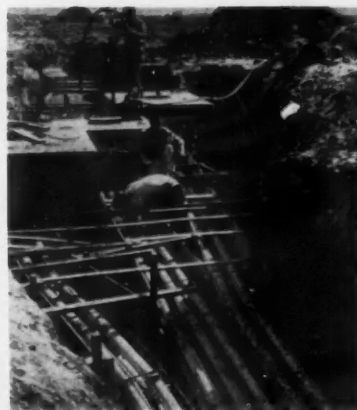
Reclamation of land was essential to the port's expansion. However, according to Bentley, "the very nature of the project injected special problems, since silt and sand contained high contents of corrosive salts which in turn could result in deterioration and expensive damage to buried conduit."

This was a major consideration, inasmuch as duct networks consist of more than 50 miles of underground ducts related to 110-, 220-, 440- and 5000-volt service for the

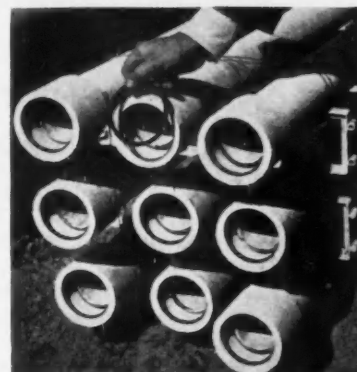
airport's power and lighting requirements. In addition, telephone and communication lines are also buried, all beneath a minimum 3-ft cover of fill having a 90-95% compaction average. In many instances, ducts were placed directly in pools of salt water prior to filling operations.

To combat this corrosion problem, Coopman Electric recommended use of asbestos cement ducts, eventually installing over 40 miles of J-M Flexjoint in 3-, 3½- and 4-in. diameters, and more than 10 miles of Korduct Types I and II in sizes ranging from 3 to 5 in. Flexjoint was selected for several reasons, including the facts that (1) flexible water-tight joints permitted a 5-degree deflection at each junction point, deemed sufficient to take care of possible land settling and duct expansion-contraction cycles; (2) a crush resistance of 2500 lbs insures against breakage under normal loads; and (3) the non-metallic raceways precluded fusion of power feeders to ducts in event of shorts.

Concentration of ductwork in some areas is impressive, as indicated by the fact that, in one 1½-mile stretch, an 8-ft-wide trench contains 3-, 3½- and 4-in. ducts related to 30 separate power, lighting, telephone and communication



**OVER 50 MILES** of asbestos cement duct were installed in this airport expansion program to carry power, telephone and communication lines. Note existence of separate manholes in above construction photo; also formwork in foreground and completed concrete pour behind grouped MHs.



**RUBBER RINGS** were inserted inside joint collars to impart elements of waterproof flexibility. Underground conduit installation represented \$½-million electrical contract, with approximately 20% of that total invested in the ducts themselves.



**BANK** of 23 asbestos cement ducts with flexible watertight joints to permit slight deflection under normal land settling conditions was placed on plastic spacer cradles prior to concrete encasement and refilling of trench.



**SALT WATER AND SILT** presented severe corrosion problem since fill for reclamation project was dredged from adjoining San Francisco Bay. Conduit was installed by 4-to 6-man crews each who handled up to 500 sections a day.

## Visit Us at the Plant Engineering & Maintenance Show

**BOOTH 1058**

**PHILADELPHIA  
CONVENTION HALL,  
JANUARY 22-25, 1962**



### HOW MUCH DOES UNPLANNED DOWNTIME COST IN YOUR PLANT? \$1000...\$5000...\$10,000 an hour?

In many cases the costs in spoiled processes and lost production amount to several times those figures.

#### **You Can't Bargain With Trouble!**

Only preventive measures will reduce it. Periodic inspection of important electrical equipment with a Megger® Insulation Tester, and the records of these tests, will provide the data you need to anticipate trouble—to prevent production line interruptions.

#### **Buy Prevention—Improve Profits**

Megger "instruments for prevention" cost only a small fraction of the price of equipment failure, work spoilage and the many other wastes that help to destroy the profits picture.

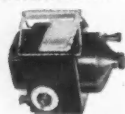
An investment in a Megger Insulation Tester is like the premium on an accident policy except that the Megger Tester can be the means of preventing the accident.

#### **Preventive Maintenance Is Productive**

Any production department will thank and even praise a preventive maintenance department for its ability to spot trouble before it happens.

*We have the answers—want them?*

**Write for Electrical Preventive Maintenance material—File 21-ECM**



**MEG® TYPE OF MEGGER INSULATION RESISTANCE TESTER**—Available hand-operated, rectifier operated, or with a separate rectifier. Ranges up to 2000 megohms and 1000 volts d-c in all three models.  
**BULLETIN 21-45-ECM**



**MEGGER GROUND TESTER** measures the resistance of earth to ground connections simply, easily and accurately, and thereby helps to determine whether such connections will perform the services for which they were designed and installed.  
**BULLETIN 25-ECM**



**JAMES G. BIDDLE CO.**

Electrical & Speed Measuring Instruments

**1316 ARCH STREET • PHILADELPHIA 7, PA.**

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JANUARY, 1962

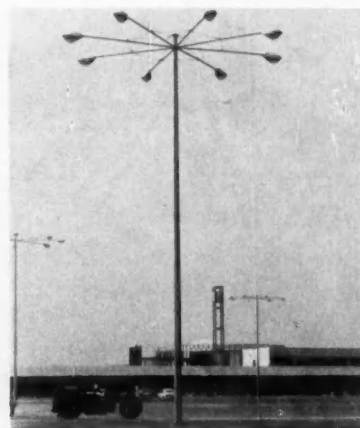
services. Ducts in all cases were specified in 10-ft lengths. And, beneath locations where jet planes would impose above-average load concentrations on runways and taxi strips, ducts were encased in concrete envelopes for added insurance against damage.

During the 5½-month underground conduit-routing project, as many as six crews were employed by Coopman, crews numbering from four to six men each being directed by job supervisor Stanley Berris and field superintendent Frank Hernaman. In several instances, initially planned duct runs had to be rerouted due to unusual amounts of salt in local silt pockets, although all schedules were maintained by crews handling as many as 500 sections of 10-ft duct in a normal day's run.

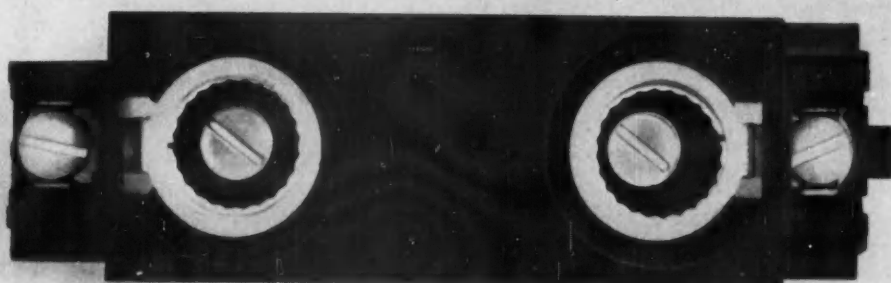
In addition to the new 10,000-ft jet transport runway, the Oakland expansion program includes new taxiways and parking lots, a central control tower and heliport, a new \$5½-million passenger terminal structure, an expanded freight terminal, plus full instrumentation facilities including up-to-date UHF omnidirectional and low-frequency radio and radar gear.

### 8-KW M-V Clusters Light Parking Area

The recently dedicated Los Angeles International Air Terminal boasts a modern, high-intensity lighting system for its automobile parking area. Ninety-six Pacific Union Metal steel standards, complementing the architectural design of the ultra-modern buildings, support mercury-vapor



**1000-WATT LUMINAIREs** are mounted around top of each lighting standard for effective lighting of airport parking area.



*look ma—no adapters!*

## now! save twice on every plug fuse circuit you wire!

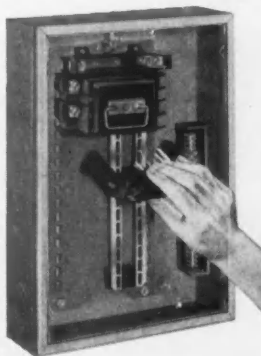
You save twice on every circuit with Federal Pacific's new Type-S stab-in fuse blocks:

**First saving:** Cost of adapters — none are required!

**Second saving:** No time lost in handling and installing adapters!

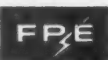
And compliance with N.E.C. requirements for Type-S non-interchangeable plug fuses guarantees inspector's approval.

This newest addition to the famous Federal Pacific SF Fusible system\* — available now in 15, 20 and 30-ampere ratings—is another reason why Federal Pacific is first in modular circuit protection!



\*The SF Fusible System: "Fully empty" enclosures and modular stab-in fusible units. You get flexibility without compromise! / Combination flush-surface enclosures. You get 2 enclosures in 1 . . . in one carton! One item to buy, one item to stock. Use the exclusive picture frame or throw it away . . . at no extra cost! / Hundreds of combinations possible—and those troublesome last-minute changes and additions are easy to make! / Engineered to be trouble-free . . . no profit-killing call-backs!

The Type SF Workbook—Bulletin FB-1-1110—is yours for the asking. Write for your copy today!



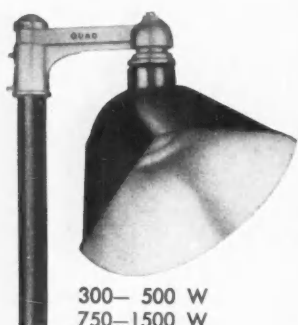
**FEDERAL PACIFIC ELECTRIC COMPANY**

50 PARIS STREET • NEWARK 1, NEW JERSEY





# FOR *Natural* FLOODLIGHTING



INCANDESCENT

RECTANGULAR  
ROUND  
ELLIPTICAL  
SCOOP  
REFLECTOR SHAPES

- Porcelain Enamel Finish
- Cast Aluminum Slip Fitters
- Swivel Socket Head
- Enclosed Wiring

WRITE FOR  
CATALOG No. 9A

**QUADRANGLE MFG. CO.**  
32 S. PEORIA ST.  
CHICAGO 7, ILLINOIS

luminaires which produce six foot-candles of illumination over a vast paved expanse, accommodating 5,251 cars.

The main parking area has 60 standards, each 57-ft tall with eight 15-ft arms equipped with M-1000 luminaires. Thus, a total of 8,000 watts is projected through 360 degrees from each standard. These units are set 160-ft apart.

Other components include 30-ft tall, single- and double-arm steel standards installed at approaches and supplemental locations.

All of the mercury-vapor luminaires provide even, color-improved lighting. The 1,000-watt lamps are good for 9,000 hours, or two years of service; the 400-watt lamps are designed to operate for 12,000 hours, or three years.

The parking area lighting system was designed by J. S. Hamel, Electrical Engineer, and installed by Sherwin Electric Service.

## Decentralized Battery Charging Saves Time

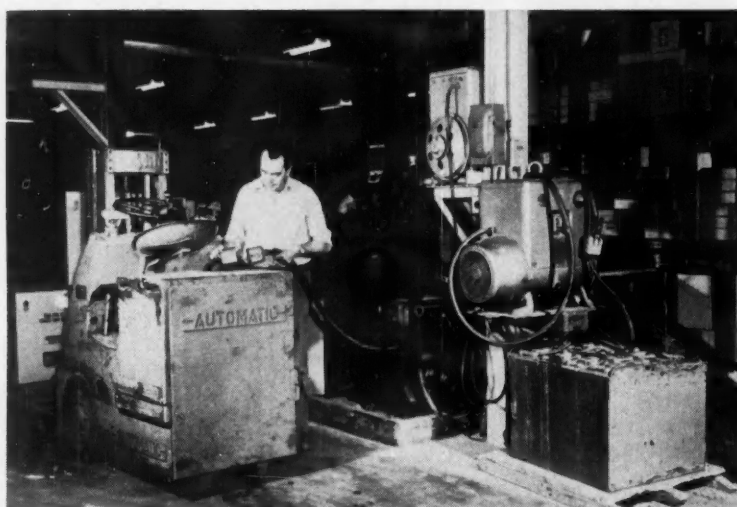
Decentralized battery charging saves time and speeds production at the Amerock Corporation, Rockford, Ill. Because this expansive hardware manufacturing plant covers 450,000 sq ft on a single floor, department supervisors, expeditors and others, as well as certain materials, must travel relatively great distances. To save time and speed production, 21 electric trucks carry personnel and move material.

With this number of trucks located in remote areas, a central battery-charging room would require excessive truck travel. To save time, five battery-charging stations are spotted close to the truck's regular operating area. These trucks include eight rider type, 11 electric hand trucks and two special trucks adapted for order picking. Rider trucks are assigned to specific areas such as receiving and shipping. Electric hand trucks are assigned to specific departments.

Motor-generators supply the charging current at all stations. Automatic controls regulate the charging current, and timer-relays terminate the charge at the proper time. To conserve space and to protect charging equipment, chargers are placed at the foot of building columns or mounted on the column. At some charging stations, three batteries can be charged at the same time.

Battery charging and servicing of trucks are under the supervision of the plant engineer. Trucks are serviced in a central shop located roughly in the center of the plant. Batteries are cleaned (but not charged) periodically in the same shop.

Amerock finds that it saves time to perform truck and battery maintenance at the truck's location when practicable. Each night, all batteries receive a booster charge. And, each week end, all batteries receive an equalizing charge. At frequent intervals, maintenance men take distilled water to each truck, water the batteries and take specific gravity readings.



**MOTOR-GENERATOR SET** charges batteries on rider truck at this 3-battery station. Space is conserved by mounting charging unit on building column. Batteries are generally charged in trucks. Spare battery on skid is receiving an equalizing charge.




*Here are five important questions . . . and their answers . . .  
on an important new Simplex development in  
electric power distribution and transmission*



# HIGH VOLTAGE POLYETHYLENE INSULATED POWER CABLES

- Q.** *What are some of the advantages of Simplex polyethylene-insulated high voltage cables?*
- A.** Low dielectric constant (nearly 1/2 that of paper cables) . . . Low power factor (nearly 1/10 that of paper cables) . . . Low dielectric loss (nearly 1/20 that of paper cables) . . . Very high insulation resistance (at least 10 times that of paper cables) . . . High dielectric strength . . . (equal to paper cables).
- Q.** *What are some of the outstanding physical properties of Simplex polyethylene?*
- A.** Light weight (62% of paper cables) . . . High tensile strength (1800-2000 p.s.i.) . . . High elongation (400% minimum).
- Q.** *Where can Simplex polyethylene cables be used?*
- A.** In many places where rubber or paper cable is used. Typical installations are direct burial, duct or conduit, aerial and submarine.
- Q.** *What is the highest voltage at which Simplex polyethylene cables are rated?*
- A.** Simplex now has polyethylene cable rated as high as 46KV A-C. Development work now in progress is expected to extend Simplex polyethylene's voltage range to 69KV or higher.
- Q.** *Has Simplex high voltage polyethylene cable been thoroughly field tested?*
- A.** Yes, as the leading producer of polyethylene cables, Simplex has in service more than 330 mile-years of polyethylene-insulated cable in the 5KV to 46KV range.

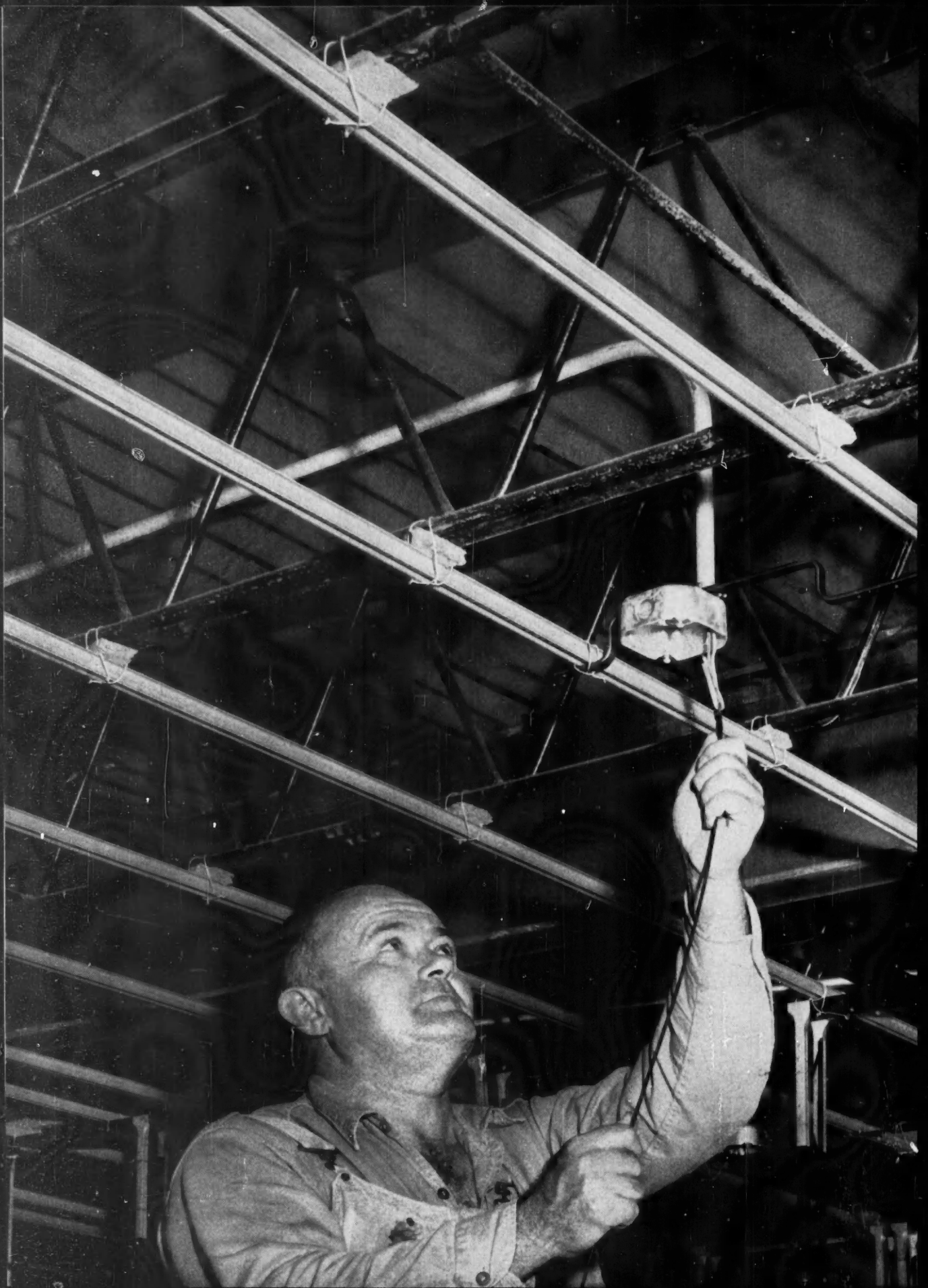
*Send for complete information.*



**Simplex**  
**WIRE & CABLE CO.**

EXECUTIVE OFFICES: Cambridge, Mass.

Plants at Cambridge, Mass., Portsmouth, N. H., Westbury, L. I., Monrovia, Calif.





# SAVINGS YOU CAN FEEL

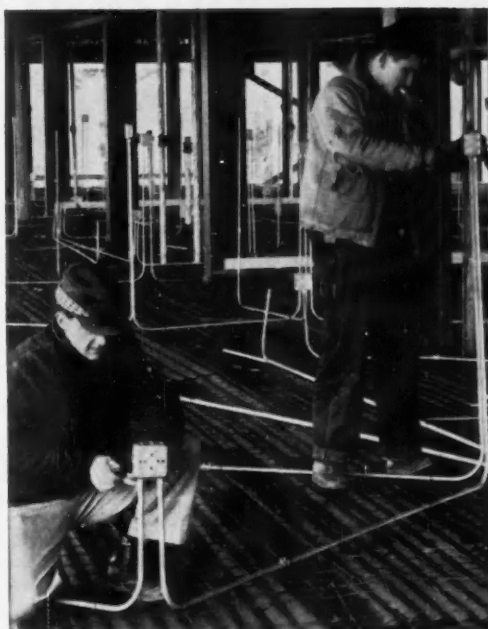
## *Up to 37% easier wire pulling through Republic ELECTRUNITE® Electrical Metallic Tubing*

You'll save time and money. Exclusive knurled interior with "SILVERSLICK"® Finish cuts friction, minimizes threat of time-consuming jam-ups or damaged wire. The dimpled interior reduces surface area, provides a ball-bearing-like surface that facilitates wire movement. In addition, a low-friction coating is applied to the tube interior.

Faster, easier wire pulling through long runs or around bends puts additional profit in your job. Contractors indicate they can push wires through longer runs of ELECTRUNITE E.M.T. than has been possible in previous experience. Strain gages show that wire pulling is *up to 37% easier*.

You save more time and money because you can bend ELECTRUNITE without fear of splits, kinks, or damage to the galvanized coating. This tube gives you close tolerances consistently. For a tight joint that seals out moisture or concrete, you merely tighten the fitting (not the tube).

How much time and money could ELECTRUNITE's exclusive features save in your electrical installations? Call your Republic representative for complete information or mail the coupon below.



**MORE THAN 260,000 FEET** of Republic ELECTRUNITE E.M.T. were installed in the new Terrace Park Apartment—largest apartment ever to be built in Cleveland, Ohio. Marvin Helf, Inc., developer and general contractor. Keeva Kekst, architect. M. Dolin Electric, electrical contractor.



**Strong, Modern, Dependable**



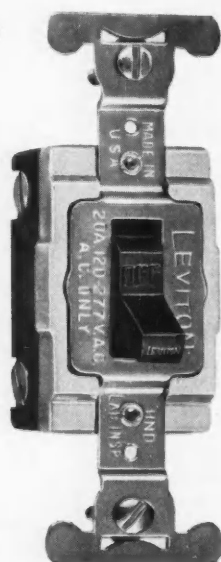
## REPUBLIC STEEL

**REPUBLIC STEEL CORPORATION**  
STEEL AND TUBES DIVISION • DEPT. A-3510  
212 EAST 131st STREET • CLEVELAND 8, OHIO

Please send more information on the installation advantages of Republic ELECTRUNITE E.M.T.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Testing a Leviton switch subjects it to the equivalent of 20 years of heavy usage. It goes on and off 30,100 times under 4 types of loads. Periodic destructive tests go up to 3,000,000 cycles to check reliability. 17 separate laboratory tests evaluate both the finished switch and all its components. Leviton maintains one of the largest wiring device testing labs in the country to bring you the **safest possible switch at the lowest possible price.**



LEVITON MANUFACTURING CO., INC., BROOKLYN 22, N. Y.  
Chicago • Los Angeles • Montreal, Canada

Contact AMERICAN INSULATED WIRE CORP.,  
Pawtucket, Rhode Island, A Leviton subsidiary,  
for a complete line of insulated wires and cable products.

Catalog #5521  
Quiet Switch 20A.277V. A.C. only  
Underwriters Laboratories, Inc. Inspected  
One of LEVITON's 60 types of switches



# Rubber Glove Test Laboratory

Initiates new customer service at Southwest Electric Co., Oklahoma City motor repair firm; offers convenient safety check to Oklahoma area contractors, REA'S and industrials.

**D**IVERSIFICATION to meet local market requirements is the rule, rather than the exception, with progressive motor repair shop management. The net result generally is plus business and improved customer relations.

Southwest Electric Company in Oklahoma City typifies this philosophy. In the past, it expanded its operations to include transformer rewinding and manufacture. Now, it has added lineman's rubber glove testing to its roster of customer service facilities. Contractors, utilities, municipalities, REA's and industrials can send in gloves, have them checked and returned with a complete test report.

The glove testing laboratory at Southwest is a comparatively small, well-lighted room that can shut out shop noise and dirt. It houses four major pieces of equipment: a glove inflator, dielectric test rack, conventional electric clothes washer and an electric clothes dryer. Con-

venient shelf space stores gloves, test report forms, rubber labels, plastic packaging bags and other accessories.

Test procedure follows this prescribed step-by-step routine:

1. Gloves are first inflated on a compressed-air pedestal. If there is any air leakage at all, the test ends here and the glove is purposely damaged to prevent further use.

2. Those passing the air test are then placed in the dielectric test rack where the water-filled gloves are submerged in a tank of water and subjected to a voltage test compatible to their rating (Class 1, 10,000V; Class 2, 15,000V; Class 3, 20,000V). ASTM specifications are followed. Imperceptible nicks and weak points will rupture under this test. Gloves that fail are further damaged to prevent reuse. Such damage takes the form of a V cut in the cuff where it is easily seen. Incidentally, this glove test equip-



**INFLATION TEST** on compressed-air pedestal is first check for pin-hole, cut, or abrasion defects in glove. Any air leakage leads to reject and end of test.

ment was originally designed and built in another motor repair shop, F. R. Hannon & Sons, Canton, Ohio.

3. All gloves that pass the test are next washed for 30 minutes in medium hot water with non-detergent soap flakes in a conventional tumbler type automatic electric clothes washer.

4. Clean gloves are then dried at low heat in a tumbler-type automatic electric clothes dryer.



**HIGH-VOLTAGE TEST** with water inside and outside of gloves uncovers defects missed by inflation check. Weak points will rupture when rated glove voltage is impressed for 3 minutes. Test equipment handles six gloves; has test range of 10,000 15,000, and 20,000 volts.

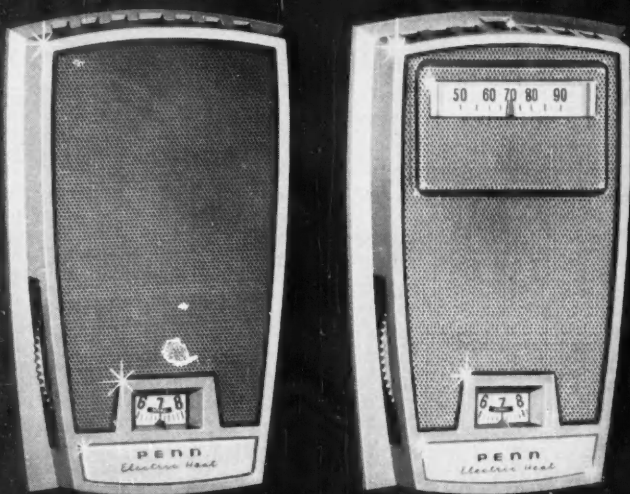


**GLOVE LAUNDRY** consists of conventional automatic electric clothes washer and dryer. Inside of glove being removed from dryer will be sprinkled with talcum. Rubber label added to glove notes test date. Test report on table above will accompany gloves returned to customer.

**PENN**

*Click Dial*

**ELECTRIC HEAT  
THERMOSTATS**



## Take your choice...you and your customers will like either one!

Whether you choose the model with or without the built-in, bimetallic thermometer, *you'll like this thermostat because it's easier and faster to install . . . your customer will like it because it has extra convenience in setting temperatures accurately . . . each "click" of its large dial is a change of 1°.*

*You'll both like it because it responds faster to temperature changes, holds temperature closely to selected level, and has the dependable performance that results in complete satisfaction.*

Slim flat front with no protrusions, the Series 800 thermostat extends only  $\frac{13}{16}$ " from the wall. Its modern styling blends in perfectly with any room decor. Get the full story, write for free Bulletin.

**PENN CONTROLS, INC.** Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING,  
APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES



5. Before being packed for return, each glove is powdered on the inside with talcum and wrapped in an individual plastic bag.

Rubber labels attached to tested gloves indicate the month and year of the test, class of glove, glove number, customer code number. With each glove goes a complete test report noting the above information plus breakdown voltages and leakage currents.

With Southwest's new facilities, customers can now establish a glove test program to match their own safety requirements.

## Inventory Enhanced by Paint, Indexing, Light

The depth of a 2 by 4 wooden stud is not great; yet, stockroom partitions so-braced can be equipped with shelves of equal depth, thereby obtaining considerable useful space for the containment of small-dimension items such as bearing sleeves and boxed or bottled small parts. When these narrow shelves are painted white, edged with slots for the placement of inventory numbers, and highlighted by good general illumination, items so stored are quickly located.

Such extra storage space is obtained by Roy M. Butcher, San Jose, Calif. And, since this section of the storage area is totally enclosed, with the access door from the shop proper normally kept closed, the area is not subjected to air-borne shop-related dust or dirt, and unauthorized personnel are not likely to wander into this partially restricted area. The result is reduced housecleaning, greater accuracy in checking inventory status and improved efficiency in necessary paper work and purchasing procedures.



**NARROW SHELVES** the same depth as the bracing wooden studs provide useful storage space for such small-diameter items as bearing sleeves, bottles and boxed parts.



## THE RACO PACKAGE

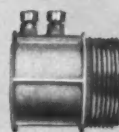
A complete line of  
Money-saving boxes and fittings



You can rely on Raco's top quality and complete line of fittings and boxes to help you do any wiring job better. Work with Raco fittings and boxes and you will see! Profit from the many user-benefits that make your job easier.

For your fitting and box needs, check Raco first. The Raco Package saves you time on-the-job.

### Time Saving Features



Clean cut threads



Burr-free edges



Smooth inner walls



Sharp, clean knockouts



ALL-STEEL EQUIPMENT INC., Aurora, Illinois



FITTINGS



BOXES





*"DAVIS T-66 is more mobile  
and does twice the work"*

**says Florida  
Contractor!**

Ask Preston Pipeliners, Inc. of Hialeah, Florida, how they like their Davis T-66's. This company recently purchased four units along with Davis Hustler trailers. The company's report follows:

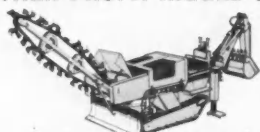


B. F. Preston of Preston Pipeliners, Inc., is shown above with 3 of his fleet of 4 Davis T-66's and Davis Hustler Trailers.

"We started off by saving \$4,000 on initial capital investment; it would cost us that much more for competitive equipment," says Preston Pipeliners, Inc., following their purchase of four Davis T-66 Trenchers. "Besides there's not another small ditching machine to compare with it. The Davis is more mobile and will do twice the work. Most of our jobs are in hard coral. It is impossible to hurt the machine because of the torque converter drive and hydraulic controls. Our best day has been 2,000 feet in eight hours working in sand with some scattered coral."

Reports like these are not unusual from owners of Davis T-66 Trenchers. Ground-gripping, positive traction with no rubber-tire bounce...high flotation—only 3.6 psi...ability to cross trenches...and compact design with only 37" width put the Davis T-66 on jobs where others can't operate. It's a real money-maker for trenches ranging from 16" wide, 24" deep to 4" wide, 66" deep. Get complete facts on all the high-performance features of the Davis T-66 today!

**OTHER PROFIT-RIGGED DAVIS EQUIPMENT**



DAVIS T-78 TRENCHER with detachable D-100 backhoe can handle any digging assignment from 4" to 36" wide to 8' 4" deep!



DAVIS W-36 TRENCHER is positively self-propelled by six-speed winch drive. Digs 3" to 6" wide to 36" deep.



**DAVIS MFG. INC.**  
1504 S. McLean Blvd., Wichita 13, Kansas

Send me free literature and tell me the name  
of my dealer for the Davis T-66 \_\_\_ T-78 \_\_\_  
D-100 Backhoe \_\_\_ W-36 \_\_\_ Hustler Trailers \_\_\_

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

TOWN \_\_\_\_\_ STATE \_\_\_\_\_

T6-5-1261

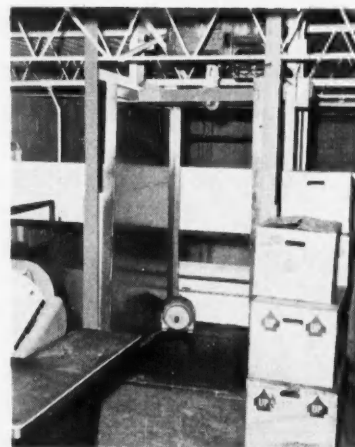
**Shop Elevator Speeds  
Equipment Handling**

Time saving equipment and material handling methods contribute substantially to the over-all efficiency of a motor shop operation. Step-saving techniques supplement mechanized repair operations to minimize costs and increase customer service. That was the basic reasoning behind the installation of a walk-in elevator between the repair floor and mezzanine storage area at McBroom Electric Company, Indianapolis, Ind.

The elevator "car" is a welded frame of 3-in. by 3½-in. steel angle with a ¾-in. steel plate floor and two sides enclosed by ¾-in. plywood panels. Frame width is approximately 40 in.; depth, 61 in.; height, 76 in. It has a 7-in. steel channel (two 3½-in. by 3½-in. angles welded together) crosspiece at top to which the hoist cable is attached.



**SHOP ELEVATOR** at McBroom Electric Co. carries motors and parts to and from mezzanine storage area. Mechanic is ready to ride up with motor.



**AT MEZZANINE** level, elevator opens on opposite side. Shaft door lowers as car rises. Note cartons of new motors at right.



# why you should specify SEALTITE

... the flexible, liquid-tight conduit available in a wide range of sizes and colors

Sealtite is the original flexible, liquid-tight conduit that gives maximum protection to wiring against oil, grease, water, dirt, chemicals, corrosive fumes, salt spray, weather.

**Installation simplified** because there is no bending of rigid conduit... Sealtite follows contours, connects outlets that do not line up.

**Longer service life** because its tough polyvinyl chloride jacket over the flexible galvanized steel core resists conditions that corrode and destroy ordinary conduit... and absorbs damaging vibration.

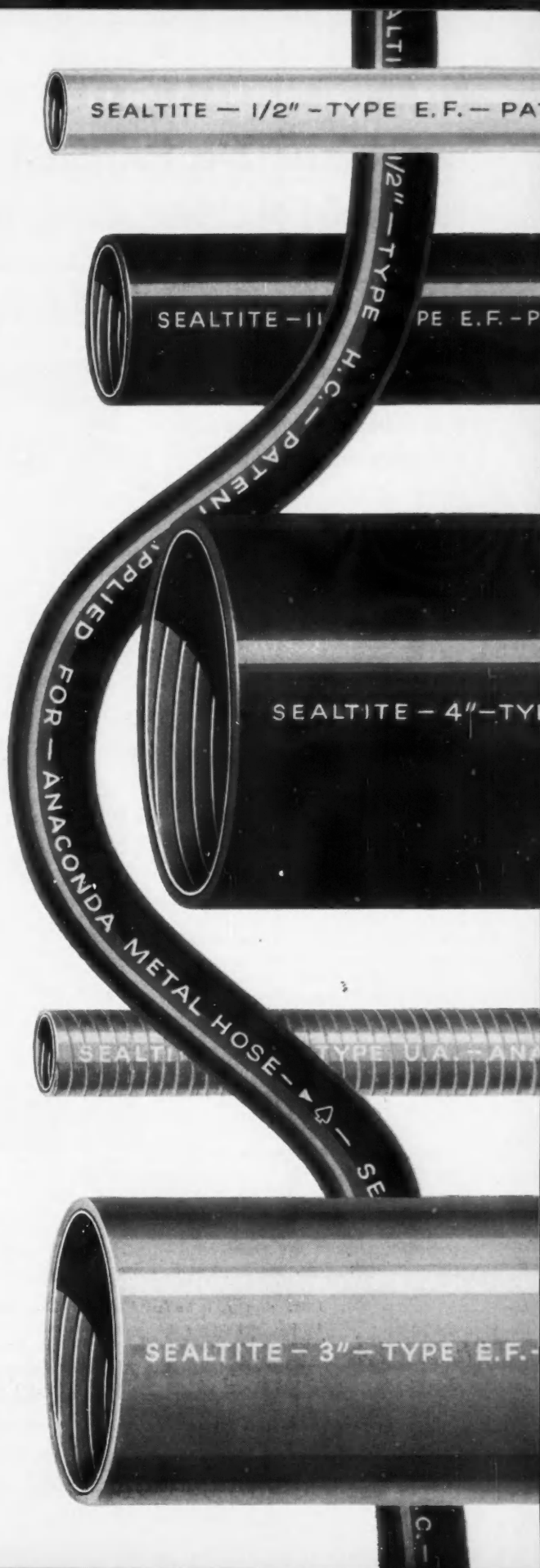
**Complete range of sizes and types.** U.A. listed under Underwriters' Laboratories label service. E.F., extra flexible, meets Joint Industrial Conference requirements. H.C. used where high or low temperatures are encountered. C.S.A. for use where Canadian Standards Association approval is required. In gray, black, white... many standard sizes... on reels, in cartons... at leading electrical wholesalers.

## SPECIFICATIONS

Trade Size (In.)	INSIDE DIAMETER		OUTSIDE DIAMETER		Approx. Inside Bend Diam. (Inches)	Feet Per Std. Coil	Approx. Shipping Wgt. (Lbs.) Per Std. Coil	Feet Per Reel	Approx. Shipping Wgt. (Lbs.) Per Std. Reel
	Min.	Max.	Min.	Max.					
TYPE UA	1/8	.484	.504	.690	.710	6	200	60	1500 460
	1/4	.622	.642	.820	.840	7	200	70	1000 365
	3/8	.820	.840	1.030	1.050	10	150	70	850 420
	1	1.041	1.066	1.290	1.315	13	100	90	600 525
	1 1/4	1.380	1.410	1.630	1.660	16	50	70	375 430
TYPE EF	1/8	.485	.505	.690	.710	4	250	60	1500 390
	1/4	.620	.640	.820	.840	5	200	60	1000 325
	3/8	.815	.835	1.030	1.050	6	175	70	850 375
	1	1.030	1.055	1.290	1.315	8	100	60	600 420
	1 1/4	1.370	1.395	1.635	1.660	9	100	80	375 360
	1 1/2	1.575	1.600	1.875	1.900	11	50	55	
	2	2.020	2.045	2.350	2.375	14	50	75	
	2 1/2	2.480	2.505	2.850	2.875	19	50	105	
	3	3.070	3.100	3.470	3.500	23	25	80	
	4	4.000	4.040	4.460	4.500	28	25	105	

Get what you specify: The conduit you receive is Sealtite only when it's marked Sealtite and Anaconda on the cover. For Sealtite Bulletin S-544, write to: Anaconda Metal Hose Division, Anaconda American Brass Company, P.O. Box 791, Waterbury 20, Connecticut.

**ANACONDA**  
METAL HOSE DIVISION



# NOW...GLOBE OFFERS... two new **INTERCHANGEABLE** trays for support of cables, wiring and tubing

- ★ Engineered for uniform design and easy installation
- ★ Steel or aluminum construction
- ★ Complete accessories for **SPEEDIER** Installation
- ★ No sharp edges to damage cables
- ★ Complete interchangeability

**Globetray**  
Pat. Pending

**LADDER TYPE**

Pat. Pending

**BASKET TYPE**

(One-piece construction)

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used **INTERCHANGEABLY** at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

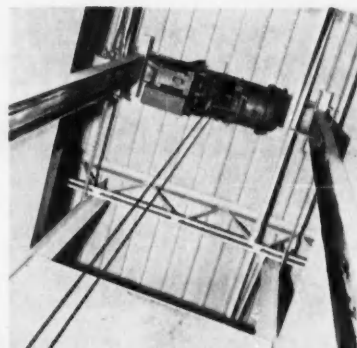
These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your **FREE** copy today.

Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.



## PRODUCTS DIVISION

*The GLOBE Company* MANUFACTURERS SINCE 1914  
4032 SOUTH PRINCETON AVENUE, CHICAGO 9, ILLINOIS



**STEEL CHANNELS** at sides of shaft maintain car alignment; supports saddle for hoist motor.

The car has a three-button control station for "up," "down" or "stop"; can comfortably accommodate a mechanic with a load of motors or parts. Weight limit is approximately one ton.

The elevator rides in an enclosed shaft formed by four 3-in. by 3½-in. steel angles running from first floor level to the mezzanine ceiling. Plywood sides and doors enclose the shaft. Doors rise or lower as the car approaches or leaves the loading position on each level. Car alignment is maintained by cross pieces which ride in 2½-in. by 6-in. steel channel guides on two sides of the shaft.

A 1-ton Shaw-Box load lifter provides motive power and a car speed of approximately 16 ft per minute. It is operated by a ½-hp, 3-phase, 220-volt motor; has an electrically operated brake; and has shaft limit switches to control maximum car travel at upper and lower levels of the shaft.

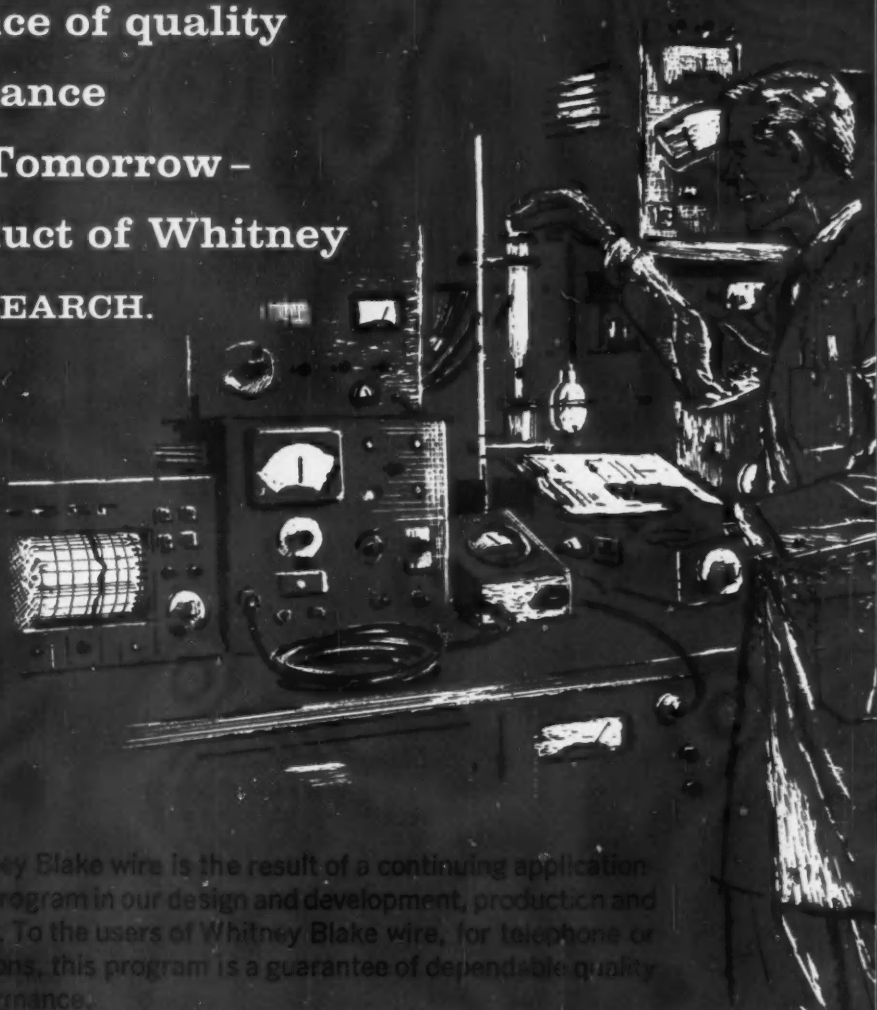


**FATHER AND SON** team of Myron (right) and Charles Evans head the Evans Electric Motor Repair Company in Oklahoma City. Here they discuss the added customer service afforded by their recent appointment as distributors for the complete line of Browning power, transmission and drive components.

FROM WHITNEY BLAKE

WI**R**ELIABILITY \*

\* Your assurance of quality  
wire performance  
- Today and Tomorrow -  
Another product of Whitney  
Blake WI**R**ESearch.



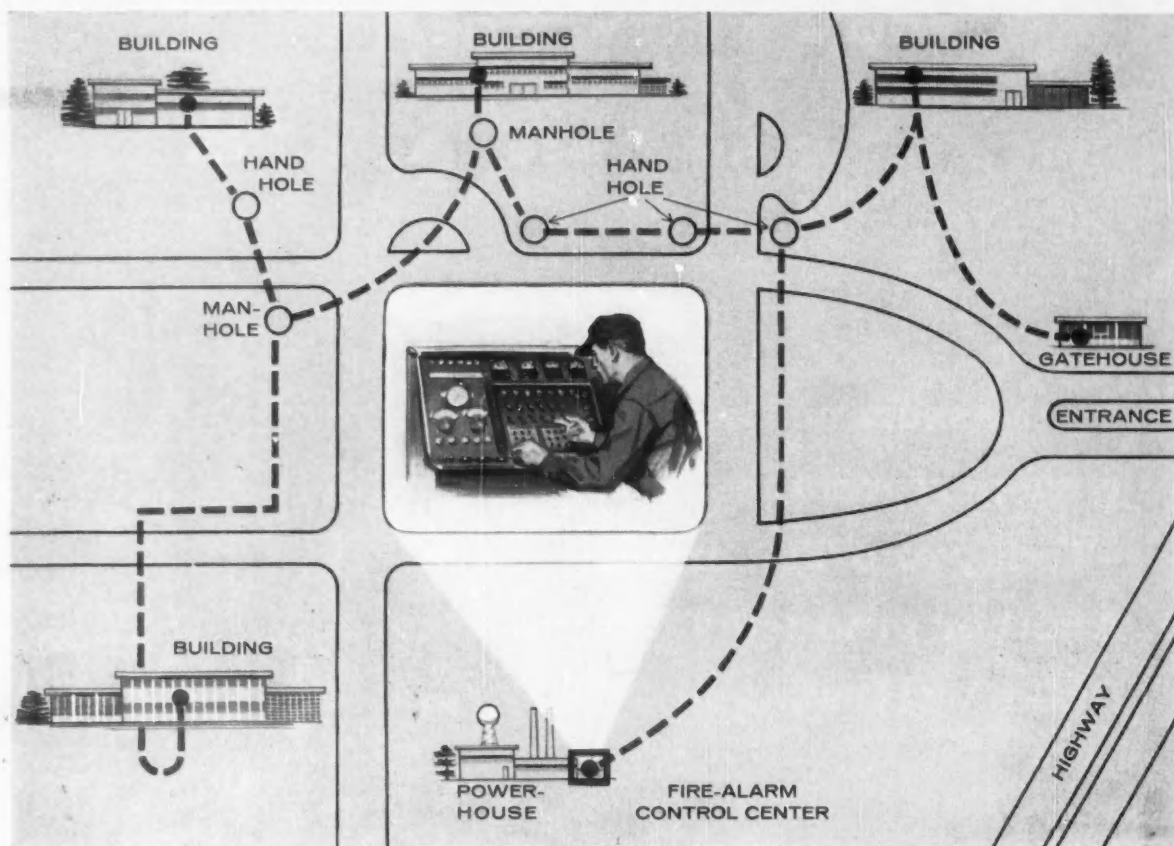
Every foot of Whitney Blake wire is the result of a continuing application-oriented research program in our design and development, production and quality control labs. To the users of Whitney Blake wire, for telephone or industrial applications, this program is a guarantee of dependable quality and long-life performance.

When you have a wire requirement, don't just buy wire, buy WI**R**eliability from Whitney Blake... in the long run it's the most economical.



NEW HAVEN 14, CONNECTICUT

TELEPHONE: Area code 203, CHestnut 8-8575 - TWY NH64



IN THIS PLANT'S FIRE-ALARM SYSTEM...

## Cable made with TEFLON® eliminates cause of failure...costly maintenance



The control cables of a fire-alarm system linking several buildings of a manufacturing plant (shown above) are now made with primary insulation and jacketing of Du Pont TEFLON 100 FEP resin. *There are good reasons why.* The jacketing previously used had been attacked by heat and moisture from a steam line adjacent to one of the underground conduits. By-products of the deteriorated jacketing attacked shielding and primary insulation. The cable shorted out... the alarm system became inoperative... a costly and time-consuming repair problem arose.

The new cable provides unequalled reliability for this vital alarm system, and minimizes costly maintenance in future years. TEFLON FEP resins are rated for continuous use up to 400°F., and are completely resistant to moisture, aging, and virtually all chemicals and corrosives.

New, melt-processible FEP resins now make available to industry the long life and extra reliability of TEFLON resins in the form of extruded jacketing and long lengths of wire insulation. In addition, the use of insulation of FEP resins permits miniaturization of cables—you can get twice as many conductors, twice as much power, twice as much control in each conduit.

Whatever the service conditions encountered by cables in *your* operation, it will pay you to consider the long-term economies, the extra safety and reliability made possible by TEFLON resins. Consult your supplier for more information, or write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. EC-1, Room 2507T, Nemours Bldg., Wilmington 98, Del. In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.



**TEFLON®**  
FLUOROCARBON RESINS

TEFLON is Du Pont's registered trademark for its family of fluorocarbon resins, including TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

ELECTRICAL CONSTRUCTION AND MAINTENANCE... JANUARY, 1962



# FOR MORE INFORMATION ON NEW PRODUCTS CATALOGS, BULLETINS ADVERTISEMENTS

## USE THESE CARDS

### ● PRODUCT NEWS, PRODUCT BRIEFS:

Use first line of boxes. Insert item numbers of products on which more information is desired.

### ● CATALOGS, BULLETINS AND ENGINEERING DATA:

Use second line of boxes. Insert item numbers of literature desired.

### ● ADVERTISEMENTS:

Use third line of boxes. Insert page numbers of advertisements on which additional information is desired. Where more than one advertisement appears on the page, include the manufacturer's initials.

## IMPORTANT...

- PLEASE PRINT LEGIBLY
- USE BLACK OR DARK BLUE INK
- DO NOT USE PENCIL OR RUBBER STAMP

Read your own  
personal copy.

Get the latest time and money-saving methods for

- estimating
- wiring
- maintenance

every month in

**ELECTRICAL  
CONSTRUCTION and MAINTENANCE**

Fill in this card  
and mail it TODAY!

Please send me without obligation further information about the following:

1/62

Product News and Product Briefs, Item Number

--	--	--	--	--	--	--	--

Catalogs and Bulletins, Item Number

--	--	--	--	--	--	--	--

Advertisement on Page

--	--	--	--	--	--	--	--

NAME ..... TITLE .....

COMPANY .....

ADDRESS .....

ELECTRICAL CONSTRUCTION AND MAINTENANCE — A McGraw-Hill Publication  
NOT GOOD AFTER APRIL 1, 1962

Please send me without obligation further information about the following:

1/62

Product News and Product Briefs, Item Number

--	--	--	--	--	--	--	--

Catalogs and Bulletins, Item Number

--	--	--	--	--	--	--	--

Advertisement on Page

--	--	--	--	--	--	--	--

NAME ..... TITLE .....

COMPANY .....

ADDRESS .....

ELECTRICAL CONSTRUCTION AND MAINTENANCE — A McGraw-Hill Publication  
NOT GOOD AFTER APRIL 1, 1962

*Your Name and address will be reproduced and sent to the appropriate manufacturers. Illegible or incomplete addresses may result in your not receiving the information you desire.*

## NEW SUBSCRIPTION APPLICATION CARD

YES SIR! I want to know the latest electrical estimating, wiring and maintenance methods! Enter my subscription to ELECTRICAL CONSTRUCTION & MAINTENANCE for a full year's service (13 helpful issues) for only \$3.\*

☐ Check here for two years at \$4\* (You save \$2)

(\* United States only. Canadian and overseas rates on request.)

NAME ..... TITLE OR POSITION .....

ADDRESS ☐ Home ☐ Business .....

CITY ..... ZONE ..... STATE .....

CO. NAME .....

OUR MAIN BUSINESS IS .....

I am in charge of Electric Work ☐ YES ☐ NO Operate a Motor Service Shop?

Person in charge of Elec. Work is ..... ☐ YES ☐ NO

Please do not  
write in this  
box.

EC-

U-

**Send No Money Now—Simply Mail Card Today!**

EC-RS-1/62

PLACE 3¢  
STAMP  
HERE

The Editor  
ELECTRICAL CONSTRUCTION AND MAINTENANCE  
330 West 42nd St.,  
New York 36, N. Y.

PLACE 3¢  
STAMP  
HERE

The Editor  
ELECTRICAL CONSTRUCTION AND MAINTENANCE  
330 West 42nd St.,  
New York 36, N. Y.

*Your Name and address will be reproduced and sent to the appropriate manufacturers. Illegible or incomplete addresses may result in your not receiving the information you desire.*

FOR MORE INFORMATION ON

## NEW PRODUCTS CATALOGS, BULLETINS ADVERTISEMENTS

### USE THESE CARDS

● **PRODUCT NEWS, PRODUCT BRIEFS:**

Use first line of boxes. Insert item numbers of products on which more information is desired.

● **CATALOGS, BULLETINS AND ENGINEERING DATA:**

Use second line of boxes. Insert item numbers of literature desired.

● **ADVERTISEMENTS:**

Use third line of boxes. Insert page numbers of advertisements on which additional information is desired. Where more than one advertisement appears on the page, include the manufacturer's initials.

### IMPORTANT...

- PLEASE PRINT LEGIBLY
- USE BLACK OR DARK BLUE INK
- DO NOT USE PENCIL OR RUBBER STAMP

FIRST CLASS  
PERMIT No. 64  
NEW YORK, N. Y.

#### BUSINESS REPLY MAIL

No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

McGRAW-HILL PUBLISHING CO., Inc.

**Electrical Construction & Maintenance**

330 WEST 42nd STREET

NEW YORK 36, N. Y.

**N O W**

is the time to put

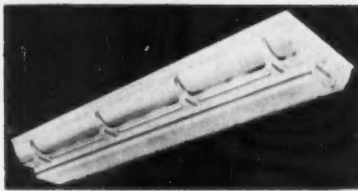
**ELECTRICAL  
CONSTRUCTION  
and MAINTENANCE**

to work for you!

Mail the attached card

**T O D A Y**

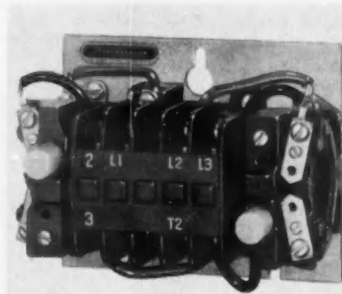
# Product News



## Fluorescent Fixture (1)

New Power-V fluorescent fixture line is designed for all types of industrial lighting applications. All models produce both 10% and 25% (nominal) "up-lighting." Fixtures are adaptable to 430 ma rapid start and instant start lamps, 800 ma high output rapid start lamps plus all types of 1500 ma extra high output rapid start lamps. Literature is available.

*Sylvania Electric Products Inc., One 48th St., Wheeling, W. Va.*



## Starter (2)

A new Size 00 starter for general purpose motor applications of 2 hp and below. A non-reversing magnetic unit, the starter has a maximum rating of 2 hp at 440/600 volts. It is available as a 3-pole device open, or in a NEMA 1 enclosure with two or three snap-action bi-metallic disk type thermal overload relays. Built-in pushbuttons and selector switches are available for enclosed types. Starter is designed primarily for across-the-line starting and stopping of squirrel cage induction motors.

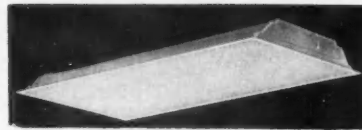
*Westinghouse Electric Corp., Standard Control Div., Beaver, Pa.*

## Adapter (3)

A new conduit riser adapter to aid in the extension of underground secondary distribution systems is available. It provides a convenient means of terminating conduit in power pedestals for above-ground connection of secondary services to mains. Prefabricated of bitumi-

nized fibre, the adapter assembly provides for leakproof junction of four 2-in. conduit runs for secondary services, and two 3-in. conduit runs for secondary main interconnection. It is designed for use with standard Type II (direct burial) fibre conduit and fittings.

*Line Material Industries, McGraw-Edison Company, Milwaukee 1, Wis.*



## Lighting Fixtures (4)

A new enclosing element for fluorescent lighting fixtures is called "Waffletex." The lens is made of acrylic plastic. Waffletex consists of a grid pattern of 3-in. squares. Grid protrudes downward from horizontal plane to a depth of 1/4 in. Each square, or cell, is "roofed" with plastic formed into tiny light controlling prisms, making the thickness 1/4 in. over-all. These tiny prisms break up light from the lamps and minimize reflected glare. Waffletex is available in four sizes: 1 by 2 ft, 1 by 4 ft, 2 by 2 ft, and 2 by 4 ft. It fits standard Mobilex, Daylume and troffer fixtures. Brochure OD-1062 is available.

*Day-Brite Lighting, Inc., 6260 North Broadway, St. Louis 15, Mo.*

## Load Regulator (5)

In areas where demand meter rates are in effect, load regulators limit the amount of current used during peak demand periods, preventing demand penalty rates. New regulators are available in two model series; Type DD is used where first priority loads (ranges, essential motors, etc.) and second priority loads (water heaters, clothes driers, etc.) are operated on the same circuit; and Type DS is used where each load must be on separate circuits. In operation a temperature compensated bimetal element heats when the load on the first priority reaches a factory calibrated point, and the resulting action depresses a switch, dropping the second priority load until the current usage returns to normal.

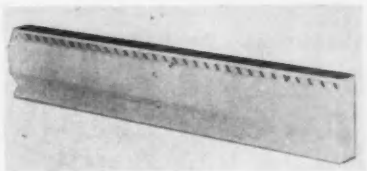
*Mears Controls, Inc., 13725 S. W. Millikan Way, Beaverton, Ore.*



## Luminaire (6)

A new fluorescent luminaire especially designed for wood-pole mounting in "private lighting" programs or for residential street lighting has been developed. Designated PMF-104B, the unit employs a single 4-ft Powergroove lamp, gives 6,900 lumens of light at 150 watts. Luminaire features acrylic plastic globe that is latched at "house side" and hinged on "street side" for easy lamp access. An adjustable wood-pole bracket is built into unit. It is available with photoelectric control and built-in locking-type receptacle. The PMF-104B was designed to be mounted about 20 ft above the ground.

*General Electric Co., Schenectady 5, N. Y.*



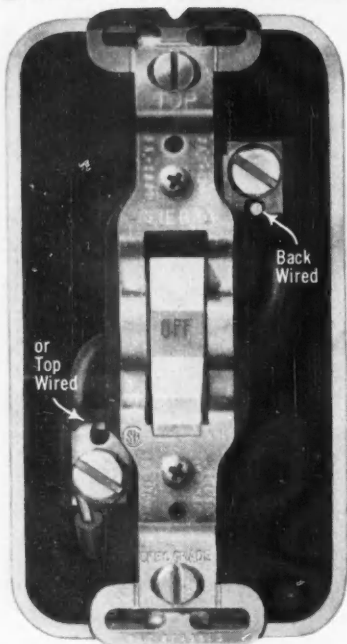
## Electric Heating (7)

A new line of electric heating equipment has been announced. One is an electric baseboard heating unit. The front plate snaps on. Back plate can be mounted during initial installation and front assemblies left in protective carton until after plastering and rough work is completed. Baseboard heater ends permit butting of units. Corner pieces and accessories are available. There are 150 watts per lineal foot of element. Baseboard convectors feature thin profile, projecting 2 3/8 in. and 5 1/2 in. high.

A combination heater, light and fan for ceiling installations is also available. Unit is 14 in. long, 8 in. wide and 8 in. high and fits between standard ceiling joists. In addition there are surface mounted radiant ceiling heaters which attach to any 3-in. or 4-in. ceiling outlet box. And a new built-in radiant wall heater provides thermostatically controlled heating.

*Anchor Manufacturing Co., Manchester, N. H.*

# SIERRA MERCURY SWITCHES



## TESTED

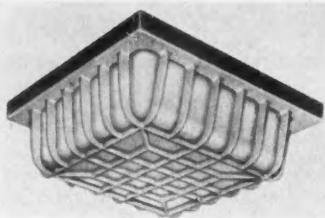
AT OUR FACTORY—  
NOT IN YOUR BOX

Some year's ago Sierra began the unprecedented procedure of testing each and every Mercury Switch under load conditions. Sierra has always contended that the place to verify a product's performance is at the factory—not after you get it in the box.

Sierra Mercury Switches are available in 1- & 2-pole, 3- & 4-way; and Sierra-lite with neon-lighted toggle handle.

**SIERRA  
ELECTRIC  
CORPORATION**  
15100 SOUTH FIGUEROA STREET  
BOX 85, GARDENA, CALIFORNIA

Write for more information and catalog



### Lighting Units (8)

A new line of Weatherite lighting units for recessing in concrete. Units are built to withstand any damaging effects of the weather. A choice of three units is available—recess round, square, or surface square units. They are designed for outdoor or semi-outdoor application. Surface units are available with or without one piece, cast aluminum guard. Recess units furnished complete with cast wiring box. UL listed. Brochure No. 119 is available.

Edwin F. Guth Co., P. O. Box 7079, St. Louis 77, Mo.

### Guard Rings (9)

Extra wide guard rings for use on mushroom-head Type C and Type D, Form RN, "Roughneck," pushbuttons have been announced. Rings protect against accidental operation yet provide accessibility for operators wearing heavy gloves. Two types are adaptable to Type C pushbuttons for use on power press and other similar applications. The deep guard ring extends  $\frac{1}{2}$  in. above top of mushroom button while shallow rings extend  $\frac{1}{4}$  in. above top of mushroom button. One other type is available for use only on Type D, Form RN pushbuttons.

Clark Controller Company, 1146 East 152d St., Cleveland 10, Ohio

### Telephone Systems (10)

A new line of selective ringing, centrally supervised telephone systems is designed for private intercommunication in schools, hospitals, offices, and factories. Controlled from two styles of master phones, a single system may have as many individual telephones or substations as desired. Wall type handsets may be installed either flush or recessed. Two styles are similar to conventional handsets while a third is a desk type phone. A system can be installed in conjunction with a master clock signalling system, using the same buzzers for telephone signalling. Master phones can be installed with the signal

distribution panel. Another feature is a two-position intercom control switch. A special unit, operating at 115 volts, 60 cycles, one amp, provides 6 to 9 volts dc power for talking circuits.

Cincinnati Time Recorder Co., 1733 Central Ave., Cincinnati 14, Ohio

### Protective Device (11)

New ground fault protective device instantaneously recognizes undetected low value ground faults and clears the circuit automatically to prevent damage to equipment and buildings. The device, applicable wherever power is used in a low-voltage distribution system, monitors circuits for ground faults, and opens switch by a delayed action relay. If a ground fault does not clear through normal overcurrent protective devices during preset relay delay, this device instantly opens circuit by energizing the main switching motor. The new devices protect both existing and new systems. Bulletin P-134 is available.

Pringle Electrical Manufacturing Co., 1900 North Sixth St., Philadelphia 22, Pa.



### Controller (12)

A new line of fire pump controllers is available as across-the-line and primary resistor manual and automatic controllers. They are front accessible and front operated to provide a space saving design which can be positioned tight against a wall or mounted side-by-side with other equipment. All connections, inspection and maintenance operations can be handled from front of controller. Applied in conjunction with centrifugal fire pumps, squirrel cage motors and automatic sprinklers, these controllers maintain proper water pressure and insure its availability in event of fire.

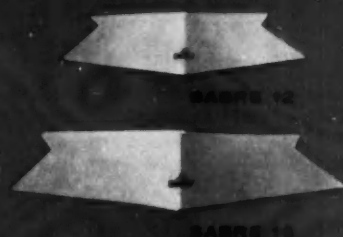
Cutler-Hammer, 315 North 12th St., Milwaukee 1, Wis.



The Pace-Setting Sabre by miller...

... now in **TWO NEW SIZES** at **LOWER PRICES**

# SABRE



- Two new sizes meet virtually any requirement
- 2, 3 and 4 LP. units in 4 ft. and 8 ft. lengths
- New, self-hinging closures of prismatic plastic

## FOR LIGHTING SCHOOLS, OFFICES, STORES

Now, you can choose a SABRE to satisfy practically any of your general lighting needs. Sabre, the *original*, prismatic plastic wrap-around fixture has been completely redesigned to provide you with full flexibility for today's and tomorrow's lighting requirements. Performance and quality are high as ever; prices are so low you'll find them pleasantly surprising. The end result is the most fixture-per-dollar yet!

**TWO NEW SIZES**—Sabre 12—2 lp. unit, with a generous 13 $\frac{3}{8}$ " width. Sabre 16—2, 3 & 4 lp. units 17 $\frac{3}{8}$ " wide.

Both of these new SABRES are now available in 4 ft. and 8 ft. channels.

**NEW, SELF-HINGING CLOSURES** in convenient 4 ft. length provide easy access from either side for relamping and cleaning. Closures are of crystal-clear, prismatic plastic offering excellent lighting *efficiency* and brightness control. Choice of light stable grade Polystyrene or Acrylic lenses.

For a free four-page folder describing these new Sabre fixtures in full, write Dept. 162 or contact your Miller Representative.

THE miller COMPANY • MERIDEN, CONN. • UTICA, OHIO



Now Available... the **EASIEST**  
**CLINCHING** fitting in the industry!

# ETP INDENTER COUPLINGS & CONNECTORS

- Special Soft Steel for Easy Crimping
- Solid One Piece
- Rolled Thread
- Concrete Tight
- Competitively Priced
- 1/2", 3/4", and 1" Sizes.



ETP makes clinching easy with this new type coupling and connector. A **dead soft steel**—especially formulated and processed—is used for easy crimping.

- Precision rolled thread for 65% greater strength.
- One-piece solid tubular steel — cannot open or spread.
- Sparkling corrosion-resistant zinc chromate overplating.
- Far exceeds requirements of UL file card No. 24788.

CONNECT WITH **ETP** FOR ECONOMY!

WRITE TODAY FOR SAMPLES AND PRICE LIST  
INDIVIDUALLY TESTED  
FOR UNIFORMITY  
AND PACKED  
IN HANDY  
EASY-TO-  
IDENTIFY  
BOXES



# ETP

ELECTRICAL TUBULAR PRODUCTS

74-16 GRAND AVE., MASPETH (N.Y.C.), N.Y.  
DEtender 5-0000



## Rectifier

(13)

A general-purpose silicon rectifier is for use in industrial and commercial applications where dc voltage is standard. It is available in one compact size for all ratings which range from 100 to 300 kw, 208 to 575 volts, 3-phase, 60-cycle ac, at 125 or 250 volts dc. Unit has overload ratings of 125% for two hours and 200% for 10 seconds—following continuous loading at 100% in either case. Complete rectifier measures 58 in. high, 28 in. deep and 36 in. wide. It can be installed in less than 8 sq ft.

I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia 30, Pa.

## Transformers

(14)

Redesigned industrial power transformers, featuring less floor space, simplified up-rating, increased capacity and reduced maintenance. The product improvements have been applied to Preferred Design units rated 10,000 to 25,000 kva. Size reductions mean existing transformers can be replaced with new, higher-rated units of the same or smaller physical size. Future increases in load can be handled by one of the new triple-rated Preferred Design units. G-E Permalux transformer insulation system gives 12% more capacity.

General Electric Co., Schenectady 5, N. Y.

## Controls

(15)

A new line of motor speed controls is called "Servojust." Units are single phase, standard voltage from 1/12 hp through 1 hp and are 3-phase above 1 hp. They can be supplied matched with performance rated P.I.C./Century motors. Literature is available.

Pacific Industrial Controls, 1212 Sixth St., Berkeley 10, Calif.

## Switches

(16)

A complete line of Programatic time switches has been introduced. Powered by synchronous, indoor-outdoor motors, the switches are available at 30, 40, 50 and 70 amps. ON time may be as low as 5 minutes for preheating industrial ovens, or 30 minutes to 23½ hours for billboard and store front advertising, or for all-night lighting of institutions and apartment halls.

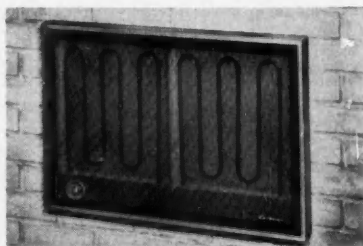
M. H. Rhodes, Inc., Hartford, Conn.

## Transformer

(17)

A new transformer features thermal protection provided by a dual-element fuse. The internally mounted fuse of the new Type TIP transformer does triple duty—protecting for overload, short circuit, and incipient internal fault conditions. One element of two in series protects throughout the overload and low-value fault range of 2.5 to 20 times rated current. The other element has a higher continuous current rating than the overload element and is thermally designed for operation in the short-circuit range of 20 to 50 times rated current. Type TIP transformer is available in sizes 10 through 50 kva and voltages through the 18-kv class for 14400/24940GrdY service.

Pennsylvania Transformer Div., McGraw-Edison Co., P. O. Box 330, Canonsburg, Pa.



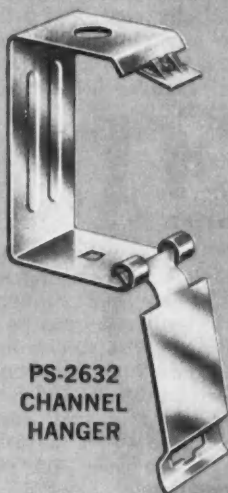
## Electric Heater

(18)

A new heavy duty surface mounted automatic electric heater has been announced. The CK Kwik-Tatch heater mounts on the wall and extends 2¼ in. Every CK model heater has thermal cut-out, designed to automatically shut off the heater if it overheats. Built-in liquid-filled thermostat provides automatic control. Finish is beige and charcoal gray with solid aluminum reflectors. The line consists of four models—from 1500 to 4000 watts at 240 volts, or 1130 to 3010 watts at 208 volts.

Cavalier Corporation, Electric Heating Div., Chattanooga 2, Tenn.

Now... the  
fastest,  
easiest  
way  
to hang  
raceway  
channel...



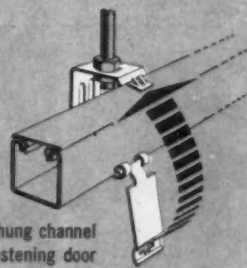
PS-2632  
CHANNEL  
HANGER



1. Suspend and align PS-2632 Channel Hanger from threaded rod at pre-determined level.



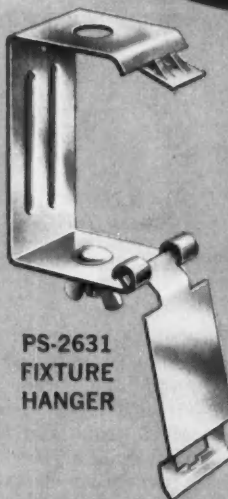
2. At floor working level install wiring in channel raceway.



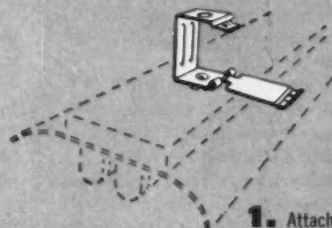
3. Lay raceway into pre-hung channel hanger. Close snap fastening door which securely locks raceway into position.

## POWER-STRUT

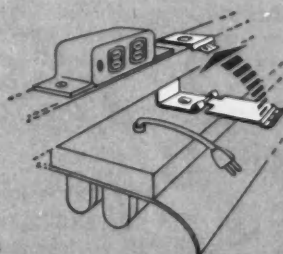
...and  
fluorescent  
fixtures...



PS-2631  
FIXTURE  
HANGER

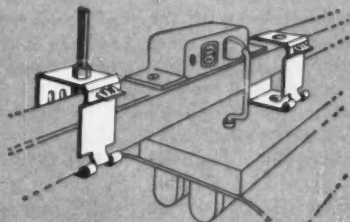


1. Attach PS-2631 Fixture Hanger to fixture with quick assembly wing-nut leaving door open.



2. Hook fixture over raceway. Close snap fastening door which securely locks fixture into position. Plug in fixture.

3. Complete installation in minutes. No screws, bolts or cotter pins to lose.



### THIS FREE CATALOG

has 24 pages packed with money saving framing and electrical support ideas. Write for it today.



POWER-STRUT DIVISION • VAN HUFFEL TUBE CORPORATION • WARREN • OHIO

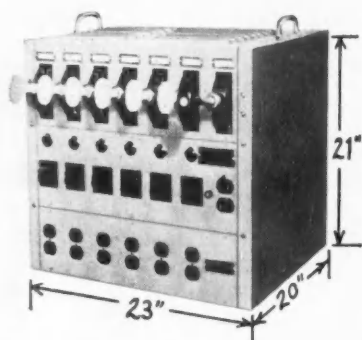
SEE IT  
DEMONSTRATED  
BOOTH 405  
MAINTENANCE  
& ENGINEERING  
SHOW  
PHILADELPHIA  
JAN. 22-25



# NEW!

## CONTROLETTE<sup>®</sup>

### lighting control



Here's a new, complete "packaged" lighting controller that gives your customers "most for the least."

It's Ward Leonard's CONTROLETTE... modern, functional, flexible, ideal for churches, schools, small TV studios, local theatres, restaurants, stores... any application except those requiring relatively complex switchboards.

Available in sizes of 3, 4, and 6 units at 2500 watts each giving system capacities of 7,500, 10,000, and 15,000 watts respectively... plus a new three-unit CONTROLETTE rated at 6,600 watts each for a total of 19,800 watts!

Here are just a few of CONTROLETTE's most outstanding features:

- Compact, portable • Low in cost • Smooth, close control • Circuit completely protected • Easy to install, easy to operate • Equipped with "master" and interlocks for grouping • Highly flexible in application.

Write for full details.  
Ward Leonard Electric Co., 28 South Street,  
Mount Vernon, New York.



RESULT-ENGINEERED CONTROLS  
**WARD LEONARD**  
**ELECTRIC CO.** MOUNT VERNON NEW YORK  
RESISTORS • RHEOSTATS • RELAYS • CONTROLS • DIMMERS



#### Switch

(19)

A new 60-amp general duty safety switch has been introduced. It features a quick-make, quick-break mechanism and a new handle which permits ganging on 9-in. centers. The new enclosure, available in NEMA Type 1 or raintight construction, minimizes mounting space, yet provides larger gutters suitable for aluminum wire plus new aluminum lay-in lugs for easy wiring. Safety switch exceeds NEMA LD switch standards.

Square D Company, Mercer Rd., Lexington, Ky.

#### Panelboards

(20)

An all new EDP Series of explosion-proof panelboards have been announced. They may also be used in non-hazardous locations where corrosive vapors, non-combustible dusts, or moisture are present. The Series feature a "pivot" between the junction and breaker housing. Panelboards are engineered to handle motor control, machinery, alarm lighting and a wide range of circuits requiring breaker capacities of 15, 20 or 30 amps. They are available for 4 to 24 single pole, 2 to 12 double pole and 1 to 8 3-pole circuits. Bulletin No. 661 is available.

Appleton Electric Co., 1701 W. Wellington Ave., Chicago 13, Ill.

#### Drill Extension

(21)

Hard-to-reach, out-of-the way drilling jobs are simplified with the help of "Danielson," a drill extension. Unit is made of light aluminum tubing 48 in. long and weighs less than 3½ lbs. Its simplified mechanism links a drive shaft with permanently-lubricated phenolic laminated bearings to a flexible cable. A gear-type chuck carries an ⅜ in. Planetor "Magic-Feed" boring bit.

Price & Rutzebeck, P. O. Box 30, Hayward, Calif.

#### Frost Cutter

(22)

The Pow-R frost cutter features a large, high speed revolving cutting wheel, with 20 hard alloy steel cutting teeth that penetrate frozen soil to a maximum depth of 20 in. Machine has a maximum cutting width of 9 in. and a digging speed up to 10 ft per minute. It is powered by a 56 hp VR4D engine and is hydraulically controlled with a Hypoid 90 or 80 hydraulic system. Mounted on two 7:50 by 15 wheels, the cutter is trailed behind a tractor, pickup or jeep.

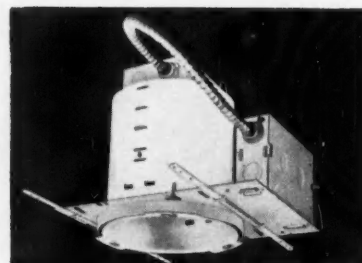
Vermeer Manufacturing Co., Pella, Iowa

#### Compartments

(23)

New PC series pickup compartments add lockable carrying space for tools, parts and equipment. Any ½ or ¾ ton pickup can be converted into a service vehicle by replacing fenders with PC compartments. Two adjustable and removable shelves are in each vertical compartment and an adjustable parts tray is in each right horizontal compartment. The PC Series are fabricated entirely of heavy gauge steel.

Utility Body Company, 1530 Wood St., Oakland, Calif.



#### Fixtures

(24)

New "All-In-One" line of pre-wired and unwired recessed fixtures has been announced. The single universal housing uses an assortment of 29 trims and incorporates "Twist-N-Turn" features. Trim frames include a wide variety of glass enclosures, as well as eye-balls, pinpoints, skirted and conical skirts, louvers and gimbal rings, plus combinations of these demands. A Marzak mirror reflector with twist-lock mounting is available for all units. With the "T-N-T" plaster frame, the entire unit can be wired in or below the ceiling and installed before or after plastering.

Markstone Manufacturing Co., 1531 Kingsbury St., Chicago 20, Ill.



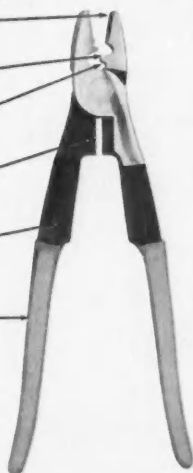
LOOK FOR THIS DISPLAY AT YOUR ELECTRICAL DISTRIBUTOR

# new crimp tool FREE



WITH PURCHASE OF SPECIAL WRAP-CAP® WIRE CONNECTOR PACKAGE

SUPER LEVERAGE  
2 CRIMP DIE SIZES  
RIGHT-ANGLE INDENTS  
SHEAR-TYPE CUTTING  
FORGED STEEL TOOL  
PLASTIC GRIPS  
TWISTS, CUTS, CRIMPS



## special offer !

New Crimp Tool ..... ~~\$4.25~~  
50 Large Connectors..... ~~3.95~~  
300 Small Connectors .. ~~8.25~~

**\$15.63** VALUE

**you pay only... \$11.28**

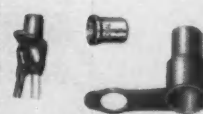
CRIMP and WRAP-CAP NOW IN 2 SIZES... LARGE and SMALL

ORIGINAL STEEL SLEEVE...

... WRAP-CAP THE UNIQUE "DIAPER-WRAP"



Splices from one #16 with one #14 up to two #10 with two #14.



Splices from one #14 with one #16 up to one #6 with two #8.

Offer expires December 31, 1961

Printed in U.S.A.

IDEAL INDUSTRIES, Inc. • Sycamore, Illinois



24-Hour Control  
Bulletin 6119



Skip-A-Day Control  
Bulletin 6119



Astro-Dial Control  
Bulletin 6022



Outdoor Control  
Bulletin 6119



7-Day Control  
Bulletin 5976



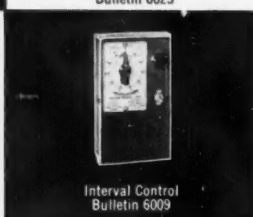
4-Pole Control  
(24-hour dial)  
Bulletin 6023



Miniature Control Mounting  
Bulletin 5901



15-Minute Control  
Bulletin 5915



Interval Control  
Bulletin 6009



**PUZZLED** about time controls?  
**PAYS** to know these **PARAGON** automatic  
time controls...they solve most any problem

How many of these precision-built Paragon Time Controls do you know? These are only a few of a complete line offered by Paragon... hundreds of models are available for practically every application in farm, home and industry. Today, Paragon is recognized throughout the world as a leader in the time control field, because all of its engineering and manufacturing skill is devoted exclusively to one product—TIME CONTROLS.

It will pay you to know more about Paragon. For more information on Paragon's complete line... location of its 88 Service Centers... contact your authorized Paragon Distributor. He carries a full line in stock, and is highly qualified to offer technical assistance on any application. There is no obligation.



**PARAGON ELECTRIC CO., INC.**

Subsidiary of American Machine & Foundry Company

1614 TWELFTH STREET • TWO RIVERS, WISCONSIN



Automatic Reset Control  
Bulletin 6002



Percentage Control  
Bulletin 6003



Cycle Repeater Control  
Bulletin 6008



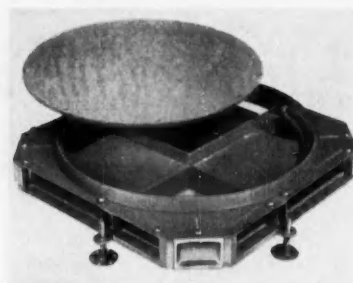
Flush Mounted Control  
Bulletin 6133



All-purpose Control  
Bulletin 6133



Air Conditioner Control  
Bulletin 6133



## Junction Box (25)

A new steel junction box for underfloor electrical distribution for use in slabs of 2½ in. or deeper is available. The box accommodates one No. 2 duct and one large capacity No. 4 duct per side. Box corner openings are designed to receive conduit adapters from ¾ in. to 1½ in. Bottom of the box has two knockouts in each compartment for 1½-in. conduit.

Walker Brothers, Conshohocken, Pa.

## Transformer (26)

A new dry-type distribution transformer has a 15-20 db reduction in noise level depending on kva rating. Designed for indoor use in industrial and commercial buildings, hospitals, schools and other institutions, the transformers are part of the standard QHT line of transformers. It utilizes a class "H" insulation system and has a 150 C temperature rise. With primary voltages of 2400 and/or 4160 volts, the transformer's secondary voltages are 120/240, 240/480, 208Y/120, 240 delta, 480 delta, and 480Y/277. Transformer ratings are 3 through 250 kva single phase and 9 through 225 kva 3-phase.

General Electric Co., Schenectady 5, N. Y.

## Fixtures (27)

The new 8600 line of fluorescent fixtures combines increased "seeability" with high level lighting. Through re-designed lamp positions, these units offer new shielding angles up to 34° which provide better light distribution and increased eye comfort. While the 8600 line is planned for all industrial applications, it is particularly suitable for conditions where corrosive atmospheres require a fume-resistant fixture. Brochure is available.

Wheeler Reflector Co., Hanson, Mass.

## Transformers (28)

A new line of 65C pole type distribution transformers will be marketed under the designation "Hi-Thermal-Cap transformers with L<sub>2</sub>FPL." This designation means "High thermal capability transformers with lower losses for peak loads." Wound cores of cold-rolled oriented grain steel are assembled through and around the coils. High thermal capability is obtained by use of epoxy-coated conductors and Insuldur insulation. Conductors and coil insulation are bonded together by thermal-setting resins to provide high short-circuit strength.

Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 33, Mo.

## Voltage Tester (29)

A new voltage tester featuring test prod grips with retractable, locking, spring-loaded spear point covers to prevent accidental contact with colored voltage bands which are visible under all light conditions. Entire unit is sealed. In addition, a voltage tester with fused prods is also offered. The fusible tester has all of the above features and may be converted to a non-fusible tester by a simple modification. Testers are furnished with a one-piece, shock-proof molded case; 30-in., heavy-duty, oil-resisting leads; and a magnetic dc polarity indicating cap.

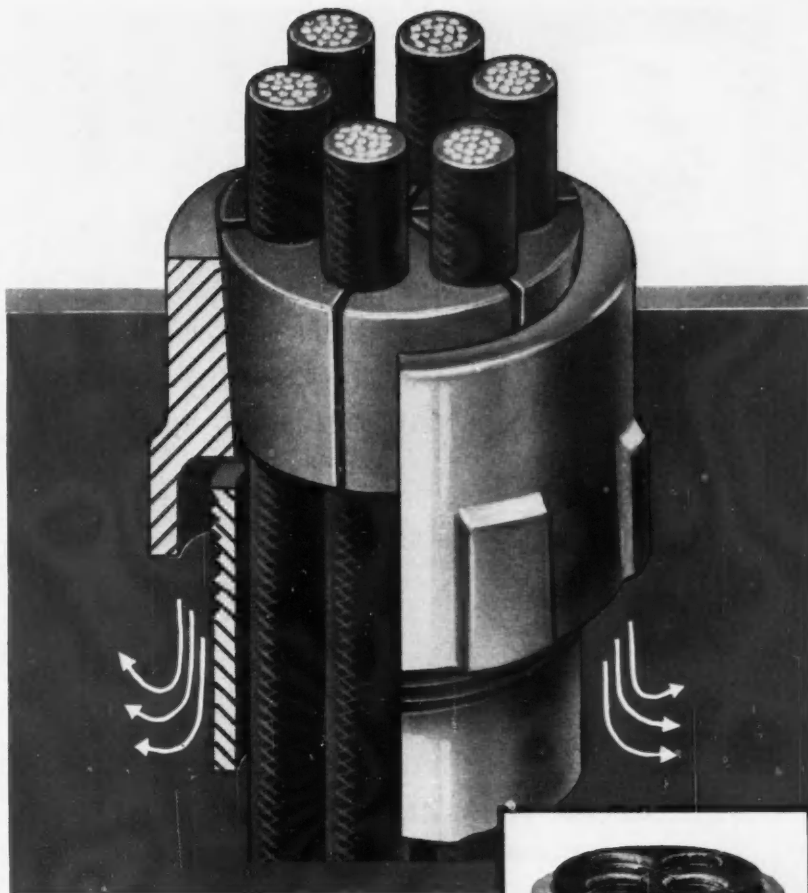
Square D Company, Mercer Road, Lexington, Ky.



## Luminaire (30)

A new line of industrial fluorescent luminaires, called the Hercu-liner, is available. Fixtures are offered in several sizes and with a variety of reflectors, shieldings, and mountings. They are made in 4- and 8-ft lengths using 425-, 800- or 1500-ma lamps. There is a choice of either solid, ventilated or slotted reflectors. They can be purchased with a center "V" shield or a metal louver. Unit can be mounted directly on a ceiling, or from conduit, slide hangers, chain and messenger cables, rods and lighting ducts.

Westinghouse Lighting Div., Edgewater Park, Cleveland, Ohio



## NOW! POSITIVE SUPPORT for cables in vertical conduit

Using Adalet fittings on vertical conduit risers makes the support of cables simple, safe and secure.

Simple, because putting the tapered, phenolic grip sections around the cables in the cast-aluminum body immediately sets up a locking action. Dead weight of the cables increases the wedging action, providing a safe means of support. Each phenolic section is long and surrounds approximately 90% of the cable for secure gripping action with minimum unit load on cable insulation. Cast-aluminum body has breather vents to dissipate cable heat, important in high temperature areas or when installing thermoplastic-insulated cable.



Vertical cable supports are available for one to six cables and for use on up to 6" conduit. All are UL-listed.

Adalet manufactures a complete line of electrical distribution system accessories. Bulletin G1259 gives you the whole story! Write today!

THE  
**Adalet**  
MANUFACTURING COMPANY

14300 Lorain Avenue  
Cleveland 11, Ohio

**2  
New**

## RIGID Tubing Cutters

Give you Grooved Rollers  
for close flare cut-offs...  
no waste! Also, Enclosed  
Feed Mechanism • Spare  
Cutter Wheel in Handle •



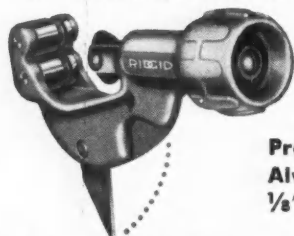
### RIGID No. 205 Tubing Cutter

Time-Saving, Slide-to-Size  $\frac{1}{8}$ " to  $2\frac{3}{8}$ " O.D. Capacity

Made of lightweight, high-strength cast aluminum alloy, you'll find these new RIDGID Tubing Cutters extra handy. Slight push on handle of large-size-range RIDGID No. 205 snugs cutter wheel against tubing... locks it in position until released. Feed screw fully protected and enclosed... always feeds into tube with easy handle turn... can't jam with chips or dirt. Wheel gives

quick, clean cuts of copper, brass, aluminum tubing and thin-wall conduit... no burr. Grooved rollers give easy flare cut-offs without tubing waste. Tubing always turns freely on 2 of 4 Rollers. Rollers smooth tubing ready for soldering. Fold-in reamer always handy. Spare cutter wheel in handle. Wheel for plastic and aluminum pipe available for No. 205 only.

Conform to Fed. Spec. GGG-C-771b Type II—Class I—enclosed feed mechanism



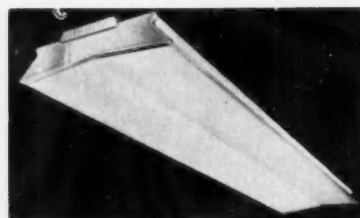
### RIGID No. 105 Tubing Cutter

Protected Feed Screw  
Always Easy-Turning  
 $\frac{1}{8}$ " to  $1\frac{1}{8}$ " O.D. Capacity

To save time on thin-wall conduit jobs, order these new RIDGID Tubing Cutters today! Your Supply House has them!

# RIGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.



### Fluorescent Fixture (31)

A shallow, surface mounted fluorescent fixture with plug-in "Unitized Electrical Assembly" is designed to permit safe operation on the ceiling surface. The new "Wingline" Series incorporates all electrical components — lamps, sockets, ballasts, wiring etc., in a single demountable assembly which plugs in to the wiring channel. When wiring channels are installed in continuous runs, fixtures can be relocated to meet changing lighting requirements. A shallow, pancake type wiring channel mounts directly to the ceiling. The 2- and 4-lamp electrical assembly plugs into an outlet built into the wiring channel. Literature is available.

Globe Illumination Co., 2121 South Main St., Los Angeles 7, Calif.

### Transfer Unit (32)

A compact automatic transfer unit, which incorporates new dual-motor drive to facilitate maintenance and remote control of molded-case breakers, has been introduced. Designed for flexible 3-way operation, the units automatically transfer electrical load from normal utility power source to an emergency source when a power failure or voltage drop occurs. When power is restored, units automatically re-transfer power to normal source. Another feature provides for both sources of power to be disconnected simultaneously. Transfer units comprise two motor-operated mechanisms and up to 103 possible combinations of other components such as relays, test switches and engine starting contacts to meet user needs. Designated Telemand automatic transfer units, they are available in continuous current ratings from 225 to 1000 amps; interrupting capacities of 50,000 amps at 240 volts and 25,000 amps at 600 volts. Interrupting ratings to 100,000 amps at 600 volts are also available with units incorporating I-T-E current-limiting Cordon circuit breakers.

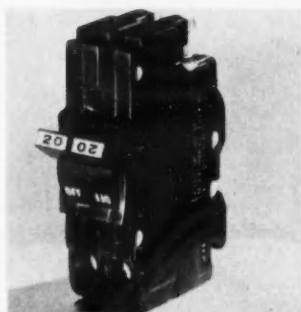
I-T-E Circuit Breaker Co., Walker Div., P. O. Box 2384, Atlanta, Ga.



## Circuit Breakers (33)

A line of 200-amp type QCC enclosed AB-I molded case circuit breakers is designed primarily for service entrance applications. Breakers are available in NEMA 1 surface mounted, NEMA 1B flush mounted, and NEMA 3R raintight enclosures, in ratings of 125, 150, 175 and 200 amps and in any of four different pole and voltage combinations. The combinations are one-pole 120/240 volts ac; 2-pole 120/240 volts ac; 2-pole 240 volts ac; and 3-pole 240 volts ac. Interrupting rating is 10,000 amps. Common trip is standard on 240-volt multiple pole units. The NEMA 1 (surface mounted) QCC AB-I measures 17 $\frac{1}{2}$  in. by 8 $\frac{1}{2}$  in. by 5 $\frac{1}{2}$  in. deep. The same enclosure is designed to accept either 1-, 2- or 3-pole breakers by the removal of cover knockouts. All enclosures contain an insulated groundable solid neutral bar with terminals which will accept either copper or aluminum terminals.

Westinghouse Electric Corp.  
Standard Control Div., Beaver, Pa.



## Breaker Unit (34)

The addition of a compact 2-pole, common-trip breaker unit to the Stab-lok line has been announced. The new 2P-NC breaker unit, designed to fit a 1-in. module, is available in ratings of 15, 20, 30 and 40 amps. The smaller size of the unit permits use of more 2-pole circuits for 240-volt appliances and electric heating. It also enables addition of new 2-pole circuits in existing installations without changing the panel box. Breaker features common-trip actuated in internal connections independent of handle tie. The centered handle has an automatic reset that permits the breaker to be turned on after fault-tripping with a single-hand motion. Unit employs 4-way compression stabs arranged so that breaker can only be plugged into opposite phases.

Federal Pacific Electric Company, 50 Paris St., Newark, N. J.



# GAT<sup>®</sup>

## NEW

### COMBINATION CONDUIT SUPPORTS

**the 1962 concept in conduit hanging**

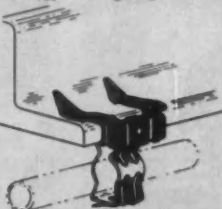
GAT—one piece assembly suspends thin wall, rigid and aluminum conduit. Now one unit replaces many costly installation operations.

#### COMBINATION CONDUIT HANGER



The Conduit Hanger Assembly combines in one (1) unit the ability to suspend  $\frac{1}{2}$ ",  $\frac{3}{4}$ " and 1" thin, rigid and aluminum Conduit from any steel flange  $\frac{1}{4}$ " through  $\frac{1}{2}$ " thick.

Pivotal, 360°, requires nothing more than a hammer and pliers for installation. The assembly comes in two (2) sizes. One (1) to fit flanges  $\frac{1}{4}$ " through  $\frac{1}{2}$ " thick, the other  $\frac{3}{4}$ " through  $\frac{1}{2}$ ".



Pivotal, 360°

#### CONDUIT BRACKET



The Conduit Bracket is designed to suspend a box flush to the underside of steel beams. It is so designed that used in conjunction with the Conduit Hanger Assembly many, if not all, bends may be eliminated. A  $\frac{1}{4}$ "-20 thread impression is provided so the box may be quickly - securely attached to the Bracket.

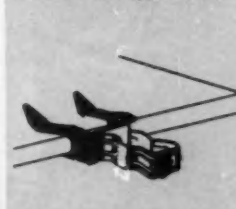


Eliminates Conduit Bends when used with Assembly

#### CONDUIT CLIP



Conduit Clips are available as single units,  $\frac{1}{2}$ ",  $\frac{3}{4}$ " and 1", or used in conjunction with the Bracket for running Conduit outside the beam. A  $\frac{1}{4}$ " - 20 thread impression on the face of the Bracket is provided for this application.



**GAT** FASTENER Div.

ERICO CADWELD PRODUCTS, INC.  
8070 EAST 61st PLACE • CLEVELAND 3, OHIO

GAT FASTENER DIVISION  
2070 EAST 61st PLACE

• ERICO PRODUCTS, INC.  
• CLEVELAND 3, OHIO

- ☐ send sample
- ☐ send descriptive sheet
- ☐ send complete GAT catalog

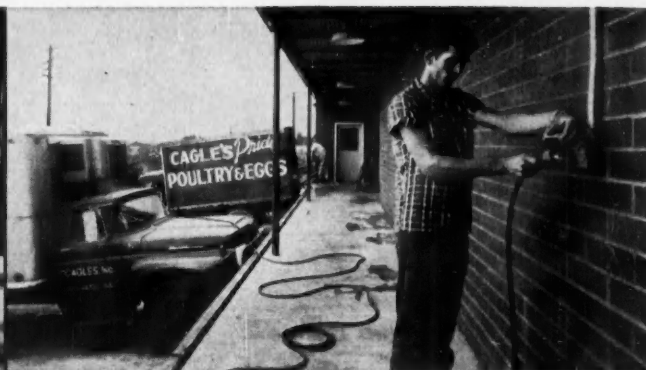
NAME \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_ ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



In sewage-disposal plant, plastic bubble on corrosion-resistant cover plate permits switch sealed beneath it to be operated safely with wet hands. Moisture can't reach metal parts of switch.



Truck dock provides current to refrigerated vehicles via corrosion-resistant receptacles, lift-cover plates, "Twist-Lock"® cord caps, and non-metallic FS boxes.

## Are corrosion-prone wiring devices corroding your maintenance budget?

You can prevent repeated replacement of wiring devices in damp or chemically destructive atmospheres by installing our new corrosion-resistant "Chem Marine"® devices.

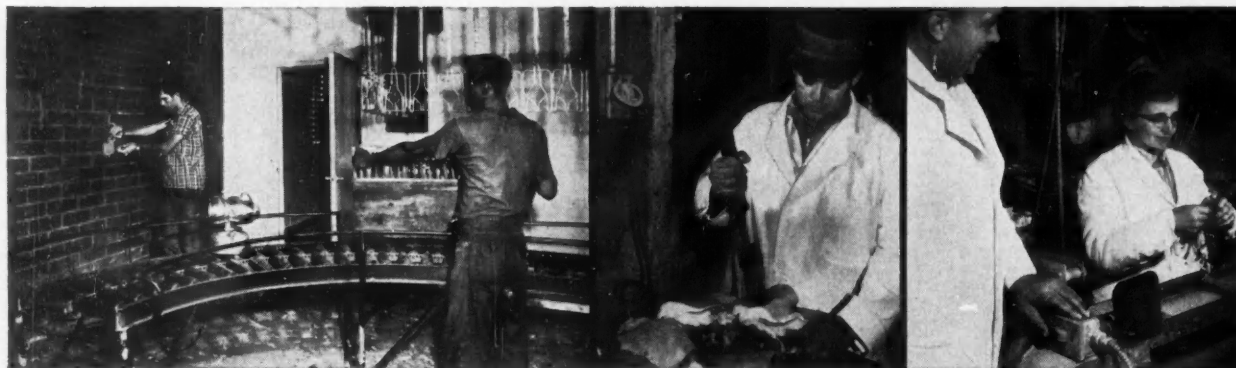
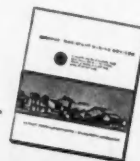
Made of materials exceptionally defiant to attack by brine, moisture, most acids, greases, and oils, these corrosion-resistant devices outlast the finest conventional equipment.

Indoors or out, their insulating and conductive elements remain unaffected by high or freezing temperatures, live steam, boiling water, and ultra-violet radiation.

Corrosion-resistant "Chem Marine"® devices are specification-grade products made only by Harvey Hubbell, Incorporated. The line includes receptacles, cord caps, cover plates, connector bodies, cap and body covers, power inlets, and non-metallic FS and junction boxes. Straight-blade, grounding, and "Twist-Lock"® configurations are available.

For complete information, write now for our 8-page, file-sized booklet:

"Corrosion-Resistant Wiring Devices".



Corrosion resistant "Fiberglas" lift cover protects "Melamine" 3-wire receptacles from the corrosive effects of hot water cleaning, a daily hazard in poultry packing plants, dairies, bakeries and kitchens.

Fats, and moisture in meat packing have little effect on corrosion resistant devices. Left, porcelain "Twist-Lock" outlet is protected by a "Fiberglas" lift cover. Right, "Presswitch" is shielded by "Insulprene" plate.

®"Chem Marine" and "Twist-Lock" are registered trademarks of Harvey Hubbell, Incorporated.

HARVEY

# HUBBELL

INCORPORATED

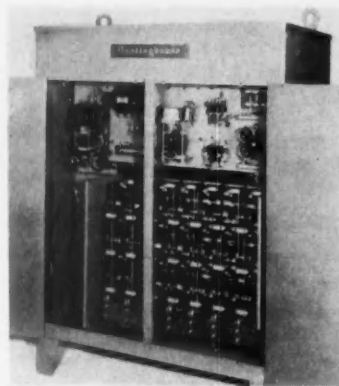
Bridgeport 2, Connecticut



Corrosion-resistant wiring devices are used throughout a large Chicago bakery. Here, lights in refrigerator are controlled by press-type switches beneath corrosion-resistant, weatherproof switch-plates.



On industrial docks and barges, electrical systems require corrosion-resistant wiring devices. Here, weatherproof lift cover plate protects 3-wire grounding receptacle mounted in non-metallic F.S. Box. At base of piling, wiring is enclosed in non-metallic Junction Box.



#### Power Source (35)

A 3000-amp silicon rectifier power source for heavy duty service and high current dc power requirements has been introduced. Called the Westing-Arc Type SRF, the unit has adjustable output current and drooping volt ampere characteristics suited to arc power requirements. Units may be operated singly or in parallel with similar or fixed output units when greater current capacities are required. Input on unit is 460 volts, 3-phase, 60-cycle. Output is rated at 3000 amps continuous dc at 40 volts load with open circuit secondary voltage at 80 volts dc. Power unit features finger tip control of output current without steps from 200 to 3000 amps through saturable core reactors. A primary contactor is provided for on-off power control through a 115-volt control circuit.

Westing-Arc Department, Westinghouse Electric Corp., Buffalo 5, N. Y.

#### Generators (36)

A new light weight portable generator, called Mite-E-Lite, produces 110-volt, ac power. They can be carried in trucks to provide power for use of power tools. Unit weighs 60 lbs and produces 1500 watts and more. They feature permanent magnets. Overload or direct short circuit cannot harm unit. A 4-cycle engine, using standard gasoline, drives the generator.

Hearth Industries, 209 Brooklyn Ave., Wellsville, N. Y.

#### Batteries (37)

Electrical capacities of nickel-iron alkaline storage batteries for material handling have been boosted up 77%. The new Type E Exide batteries produce electric current

by the transfer of oxygen from the nickel oxide of the positive plate to the sponge iron of the negative plate, in an alkaline electrolyte. They are now capable of producing 100 amp-hrs per positive plate. They produce 1.202 watt-hrs per cubic inch. Initially the E line will be available in five standard electrical sizes, 400-, 500-, 600-, 700- and 800-AH capacities, adequate for trucks rated up to 8000-lb lifting capacities. The "E" line of batteries is designed for use in many types of counter-balanced sit-down and stand-up, center-control and end-control fork lift trucks; pallet-type and fork-lift hand trucks; and tractors.

Exide Industrial Marketing Div., Electrical Storage Battery Co., Rising Sun and Adams Aves., Philadelphia 20, Pa.

#### Cable Dispenser (38)

A new type of NM cable dispenser designed especially to save time. It embodies a clamp which attaches the dispenser to a stud in building construction. Dispenser accommodates 250-ft coils of cable with various inside coil diameters. Only one thumb screw adjustment is necessary to accomplish this. It can then be loaded and unloaded without readjusting. After mounting the dispenser on a stud and adjusting for inside coil diameter, gripping arms pivotally mounted on coil carriers are unlocked from their operating positions by pulling them outward and down to load the dispenser.

C-Z Cable Dispenser Co., 7515 Sherman, Omaha, Neb.

### Product Briefs

(39) Pennsylvania Transformer Div., McGraw-Edison Co., Canonsburg, Pa., has announced a new line of distribution transformers for operation at 65C rise using recently developed Edison insulation. . . . (40) A new, completely static, self-contained battery charger with 1% regulation for electric utility, railway communication and signalling has been announced by the Rectifier-Capacitor Div., Fansteel Metallurgical Corp., North Chicago, Ill.

(41) Radiant Lamp Corp., Newark, N. J., has announced their new bubble dome for R60 and R80 re-



TESTED AND PROVEN . . .  
**THOUSANDS  
 IN USE!**



**OSTER**  
**POWER  
 DRIVE**  
**FULL 2" CAPACITY** **"100"**

Here's the original, LOW PRICED Power Drive that continues to be the "first-choice" of factory maintenance men everywhere! Compact, lightweight (only 77 lbs.), the "100" is strictly a one-man machine yet does the work of four men! See it today.

**ADD POWER TO  
 ALL YOUR  
 THREADING  
 OPERATIONS**



WRITE TODAY FOR COMPLETE INFORMATION

THE **OSTER** MANUFACTURING CO.

1313 East 289th Street, Wickliffe, Ohio, U.S.A.

flector mercury lamps. . . (42) Dialite, a compact electronic light **dimmer** has been introduced by Halo Lighting Products, Inc., Chicago, Ill.

(43) Duro-Lite Lamps, Inc., North Bergen, N. J. is now marketing a Globelite incandescent **light bulb** which measures 5 in. across. . . (44) A specially designed **cutting wheel** for use in the Ridgid No. 205 tubing cutter, which converts this tool into a plastic pipe cutter in a matter of seconds, is now being manufactured by the Ridge Tool Co., Elyria, Ohio.

(45) Lighting Products Div., Sylvania Electric Products, Inc., New York, N. Y., announces the availability of a full line of soft white incandescent **lamps** in ranges from 25 watts through 100 watts. . . (46) A new tubular-design **control** with adjustable time delay for conveyor application has been announced by Photo-switch Div., Electronics Corp. of America, Cambridge, Mass.

(47) Hunt Electronics Co., Dallas, Texas, has developed a new flexible compact electronic **light controller** known as Socialite. . .

(48) An improved DX 100-L power piston drive **tool** has been announced by Hilti, Inc., Stamford, Conn.

(49) Explosion-proof heavy-wall  **housings** with tempered glass windows in eight stock sizes are announced by the Adalet Mfg. Co., Cleveland, Ohio. . . (50) Kaiser Aluminum & Chemical Corp., Oakland, Calif., has announced a new coating in "Kingfisher" rigid **conduit**—a newly-developed silicone impregnated lubricant which dries to a finish.

(51) Western Insulated Wire Co., Los Angeles, Calif., announces the production of Bronco 66 certified Type SH-D, shielded 5000 volt, flexible, portable **power cable**. . . (52) A unique dual purpose **light bulb** which is actually two light bulbs in one, known as the Glow-Bright, has been developed by Westinghouse Lamp Div., Bloomfield, N. J.

(53) Utility Products Mfg. Co., Memphis, Tenn., has developed a new aluminum transformer and regulator **platform** marketed under the trade name of Alum-Form. . . (54) A new hammer-driven masonry fastening **tool** and a line of special new fastening



pins named "Pin Boy" is announced by Remington Arms Co., Inc., Bridgeport, Conn.

(55) Permacel, New Brunswick, N. J., has announced a new improved formulation for Permacel PA 1041 junction box mount **adhesive**. . . (56) New voltage-isolation dry-type **transformers** for portable tools and lights have been introduced by the Westinghouse Electric Corp., Pittsburgh, Pa.

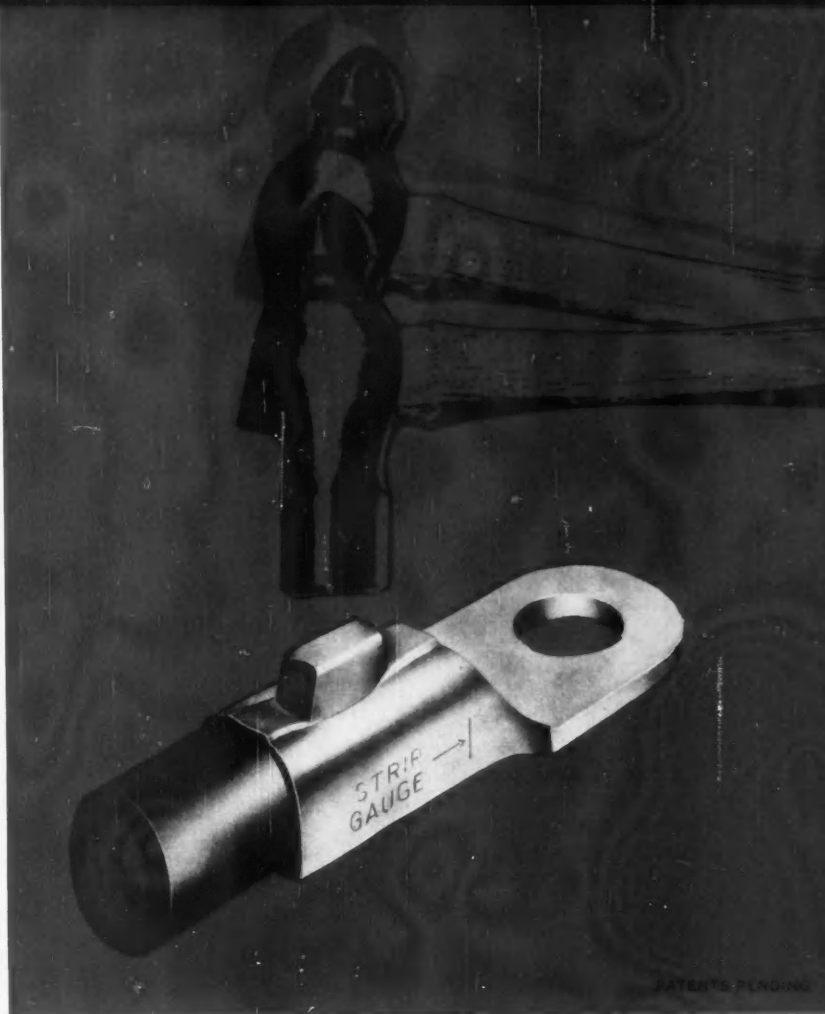
(57) Slater Electric Inc., Glen Cove, N. Y., announces distribution of a full line of B.G. series box **plaster guards**. . . (58) Development of an improved quality of rigid steel **conduit** identified as Spang Blue Star Conduit, has been announced by the National Supply Div., Armco Steel Corp., Pittsburgh, Pa.

(59) A new split bell **nozzle** that simplifies installation of protective electrical cord covers is now marketed by Steel City Electric Co., Pittsburgh, Pa. . . (60) R. E. Uptegraff Mfg. Co., Scottsdale, Pa., has increased performance ratings of some classes of substation and load center **transformers** by 15%.

(61) New 100-kvar power-factor correction **capacitors** designated Form 2 are now offered by Line Material Industries, McGraw-Edison Co., Milwaukee, Wis. . . (62) Thomas & Betts Co., Elizabeth, N. J., has announced plans to market a new line of low-cost flat conductor cable **connectors** in kits containing connectors, cables and special application tools.

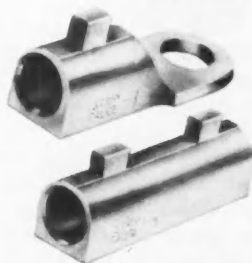
(63) The new T-78 **trencher** and dozer with backhoe, an all-purpose excavating and leveling machine capable of digging from 3 in. to 36 in. wide to 8 ft. 4 in. deep, has been introduced by Davis Mfg. Inc., Wichita, Kan. . . (64) Ammo Products, Inc., Washington, D. C., has introduced a new booster tool—a low velocity, powder actuated stud driver using a .22 caliber shell.

(65) Electric Arc, Inc., Newark, N. J., has announced the development of the "HiTemp" plate **heater**, a flat, clamp-on resistance heater for localized preheating and stress relieving of steel and alloy plate at temperatures up to 1600° F. . . (66) New Motor-Gard **fuse holder plate** with a hinged, windowed fuse cover is now available from Bell Electric Co., Chicago, Ill.



## Hamron\* hits savings on the head!

A hammer, a second, and Anderson's exclusive new Hamron\* are all you need to make a perfect connection every time!



Hamron Lugs and Splices cover a cable range from #6 through 300 MCM

Hamron Lugs and Splices are the simplest yet developed. Unequalled in pull-out strength and electrical conductance. Eliminate special tools (a hammer and a flat surface are all you need). A few blows form connector and cable into virtually one solid unit. "Hamron" cannot over compress . . . the deformed punch shows it is a tight connection. Maintenance free. It adds up to big savings in time, labor, tool costs!



**ANDERSON ELECTRIC CORPORATION**

Research/Quality/Performance in Aluminum and Bronze Products

LEEDS, ALABAMA

\*Trademark

# JOIN THE CIRCLE

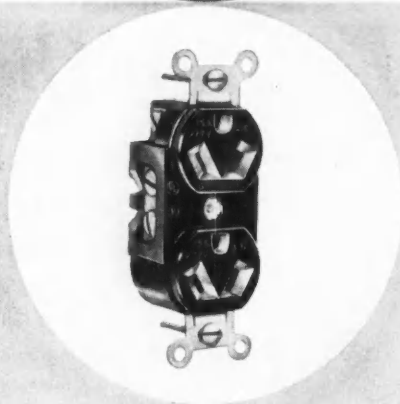
OF CONTRACTORS  
WHO DEMAND  
ONLY THE BEST!

You can't argue with successful contractors any more than you can argue with success. When a contractor tells you Circle F is his one best single source for all residential, commercial and industrial wiring devices, you can bet your bottom dollar he's successful. And you can bet he's paying bottom dollar, too. Join the circle of success, insist on Circle F.



## CIRCLE F 277 VOLT GROUNDING DEVICES

New, 15 amp. 3-wire "U" Ground devices have been designed for lighting applications and other equipment requiring 277 volt circuits. They meet all applicable Government, NEMA & ASA specifications and are UL listed.



Where interlocking and positive grounding are essential to eliminate accidental disconnects, Circle F's "Circlok" Grounding devices are ideal.

**CIRCLE F MFG. CO. TRENTON, N.J.**

## Catalogs & Bulletins

(67) **TRANSFORMERS.** Bulletin GEA-7524, 16 pages, gives detailed information on the features, application, construction and operation of new Permalex 65 distribution transformers. General Electric Co.

(68) **FULL-FLEX CABLE** suspension system is illustrated in 4-page Bulletin No. 5. Fullman Mfg. Co.

(69) **LAMP BALLASTS.** Catalog describes fluorescent lamp ballasts for sign, flashing and weatherproof applications. Universal Mfg. Co.

(70) **POWER SUPPLY CENTERS** for shopping centers, industrial plants, schools, and other outdoor applications in which space or appearance is a major factor are described in Bulletin No. 2469. Pennsylvania Transformer Div., McGraw-Edison Co.

(71) **PROXIMITY LIMIT SWITCH.** Bulletin GEA-7318 describes new CR115D proximity limit switch for detection of ferrous and non-ferrous materials without physical contact. General Electric Co.

(72) **DRILLING MACHINE.** Model MDS-400 diamond masonry drilling machine, designed for drilling holes from 1 in. to 6½ in., is described in 4-page bulletin. Sprague & Henwood, Inc., Diamond Masonry Drilling Div.

(73) **DC POWER SUPPLIES.** 56-page guide describes semiconductor power rectifiers for every ac to dc application and is available in two volumes—Industrial and Plating. The Meaker Co.

(74) **MULTIPLE CONNECTORS.** 6-page folder describes three separate lines of multiple connectors—Fastin-Faston, Ampeez and Amp-Lok—with specific data sheets for each line. AMP Inc.

(75) **ELECTRIC RECORDERS.** 12-page Bulletin GEA-6933A describes full line of direct- and servo-operated, switchboard and portable recorders. General Electric Co.

(76) **LIGHTING** fixture catalog, 96 pages, features 450 styles—more than 200 new designs. Lightolier.

(77) **ELECTRICAL PRODUCTS.** 96-page catalog illustrates over 1500 electri-

# Allen-Bradley Nema Type 4 STAINLESS STEEL ENCLOSURES for New Bulletin 709 Motor Starters



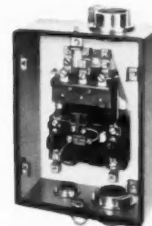
NEMA Type 4 Watertight  
and Weatherproof Enclosures



## Complete Protection Against Water and Weather!

Allen-Bradley's revolutionary, new line of Bulletin 709 motor starters, which includes reversing switches, multi-speed starters, combination starters, etc., is now available in stainless steel enclosures. Thus the benefits of reduced size, increased interrupting capacity, increased life, and longer trouble free operation can be given to all outdoor installations, or where a great deal of moisture is present. Designed for installation in dairies, breweries, meat and food processing plants and similar locations where a daily "wash-up" is required, the "eye appeal" of these stainless steel enclosures will also be an asset.

The standard Nema 4 enclosures are made of heavy gauge Type 302 stainless steel. However, Type 316 stainless steel can be furnished at a correspondingly higher price. There are many other features about these revolutionary starters that will interest you. Therefore, please write for Publication 6100: Allen-Bradley Co., 1316 South Second Street, Milwaukee 4, Wisconsin.



### BULLETIN 709 SIZE 2

in watertight, weatherproof Stainless Steel Enclosure—for use where a great deal of moisture is present, such as tanneries, food processing plants, pump houses, dairies, breweries, etc., or in outdoor locations.

9-01-2

# ALLEN-BRADLEY

Member of NEMA

**QUALITY  
MOTOR CONTROL**

# Believe me—This is THE FINEST STARTER On the Market!

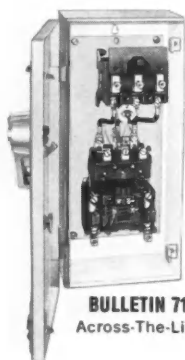
Our old Bulletin 709 line of motor control was an outstanding performer for over 20 years. It was imitated, but never equaled in performance. Now, the new Allen-Bradley Series K starters incorporate design features that have *you* in mind. Now you get *extra* switching ability for prolonged operation at maximum speed and at maximum rated capacity—an unusual condition, perhaps, but the Series K line was intended to satisfy *unusual* conditions. And, you still have ample reserve for emergency loads. In everyday operation, this means *almost* unbelievable reliability and long trouble free life.

All enclosures have modern "eye appeal" too! Why not learn *all* about the many other plus values? Please write for Publication 6100: Allen-Bradley Co., 1316 South Second Street, Milwaukee 4, Wisconsin.



New Series K Starter and  
Eye-Appealing Enclosure

## Allen-Bradley Combination Motor Control Is Built Around The Revolutionary Series K Starters



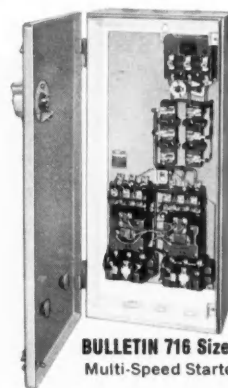
**BULLETIN 712 Size 2**  
Across-The-Line Starter

Combines new Series K starter and fused or unfused (above) visible contact disconnect switch in NEMA Type 1 enclosure. Interlock prevents opening cover while switch is on. Bulletin 713 has circuit breaker as disconnect means. Ratings to 100 hp, 220 v; 200 hp, 440-550 v.



**BULLETIN 707 Size 1**  
Reversing Starter

Consists of new Series K reversing starter with block type overload relays and ITE circuit breaker in NEMA Type 1 enclosure. Bulletin 706 has fused or unfused visible contact disconnect switch. Ratings to 100 hp, 220 v; 200 hp, 440-550 v.



**BULLETIN 716 Size 1**  
Multi-Speed Starter

Has fused (above) or unfused visible contact disconnect switch and new Series K multi-speed starter with block type overload relays for each speed. In NEMA Type 1 enclosure. Bulletin 717 uses circuit breaker as disconnect means. Ratings to 100 hp, 220 v; 200 hp, 440-550 v.

2-01-2

# ALLEN-BRADLEY

Member of NEMA

**QUALITY  
MOTOR CONTROL**



cal wiring devices, lamps and specialty products. Eagle Electric Mfg. Co., Inc.

(78) **HANGER RING.** 4-page brochure features the new Tube-Con hanger ring for tube and conduit. "Auto-Grip" Div., "Automatic" Sprinkler Corp. of America.

(79) **POST INSULATORS.** 4-page Bulletin TIA-184 describes the construction and features of two complete new lines of Locke stacking station post insulators rated from 550 to 1470 kv. General Electric Co.

(80) **LUMINOUS CEILING.** New brochure "Lighting in the Right Direction Engineered for Architects" describes application of indirect ceiling system. Silvray Lighting, Inc.

(81) **MOTOR WINDING PROTECTION.** 8-page Bulletin F-2034 describes solid-cast Eversal encapsulation for the protection of motor windings against severe environments. U. S. Electrical Motors Inc.

(82) **STREET LIGHTING.** 16-page Booklet B-8230 describes Philadelphia's mercury luminaire street lighting system. Westinghouse Lighting Div.

(83) **ADJUSTABLE SPEED DRIVES,** ranging from 1/20 to 1000 hp, are described in 32-page Bulletin GEA-6999 including product description and application, factors in drive selection, and examples of and recommendations for special application. General Electric Co.

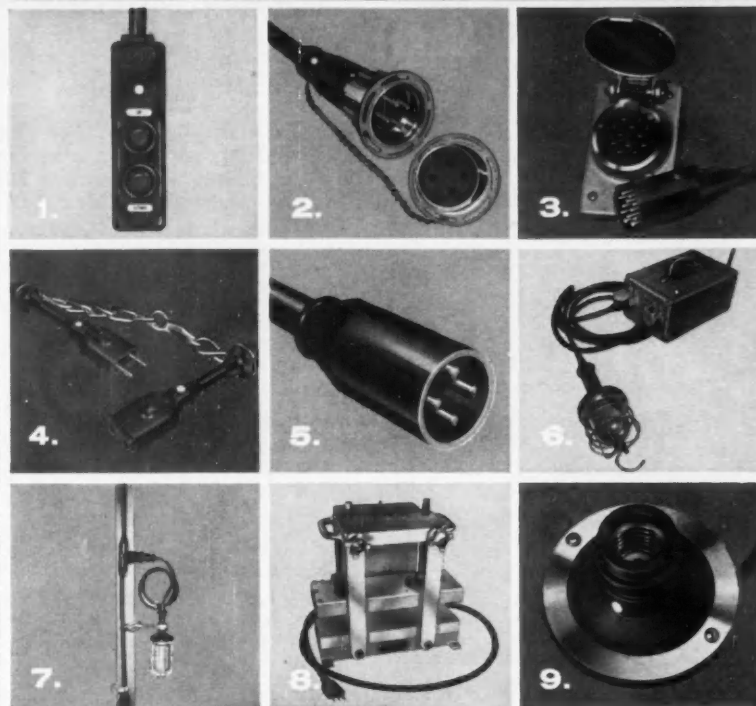
(84) **LIFTING MAGNETS.** Bulletin No. 3022 lists over 50 styles and types of circular and rectangular lifting magnets, with the circular magnets ranging in size from 20 to 80 in. in diameter and the rectangular magnets ranging from 9 to 24 in. to 26 by 80 in. Stearns Magnetic Products Div.

(85) **LIGHTING.** Solutions of problems frequently encountered in areas requiring external lighting are described in 8-page pamphlet. Wide-Lite Corp.

(86) **MOTORS AND DRIVES** used in chemical processing industries are described in 4-page application bulletin. Louis Allis Co.

(89) **BLACK LIGHT.** 12-page Booklet LS-141 provides information of black light sources, and several basic black light design procedures. General Electric Co.

# JOY



## The quality line with the built-in money-saving benefits

Rugged, durable, easy to maintain, installed for less — these are some of the many advantages engineered into Joy electrical connectors, push button stations and other equipment. Connectors and switches, for example, molded-to-cable in tough, resilient Neoprene, provide operator safety and resistance to impact, shock, vibration, corrosion and water penetration.

**1.** Switches, pendent or stationary, push-button types. 1, 2, 3, 4, 6, stations. Neoprene rubber enclosed. *Bulletin B82, B79.*

**2.** Power connectors for high voltages. Hypalon rubber encased, arc-safe, positive polarization. *Bulletin B81.*

**3.** Equipment control connectors. All-rubber molded-to-cable; 2 to 12 poles; water, air and dust tight. *Bulletin B72.*

**4.** Electric lifting magnet connectors. Shatter-proof, moisture-tight, distortion-resistant. *Bulletin B71.*

**5.** Watertight connectors for underwater service. All Neoprene,

multi-pole, sealed against water penetration even at high pressures. *Bulletin B78.*

**6.** Low-voltage lights. Safe handlamp for lighting around grounded equipment, metal structures. *Bulletin F45.*

**7.** String-A-Light portable lighting assemblies. For industrial lighting, construction, derricks, mines, other multiple-lighting installations. Vaporproof, watertight. *Bulletin B52A, B66.*

**8.** Cable vulcanizers. Direct heat; bench or portable types. For repairing or splicing rubber, synthetics and plastic jacketed cable. *Bulletin B70A.*

**9.** Shatter-proof Neoprene bulb sockets. Dampen vibration, prolong filament life. *Bulletin B71.*

Send Today for the Bulletins you need.

CD 1281.1

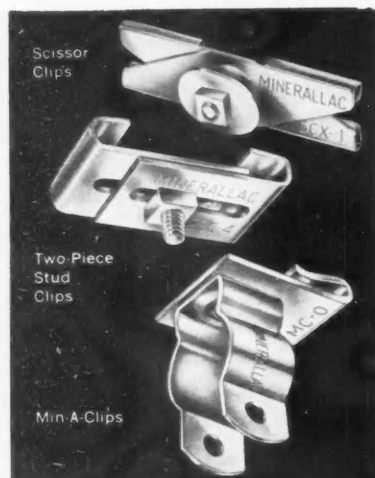
**JOY** ELECTRICAL PRODUCTS DIVISION

1231 MACKLIND AVENUE  
ST. LOUIS 10, MISSOURI

New Installation Economy  
For Difficult Mounting Jobs!  
Save Time and end guesswork with  
"SIZE-MARKED"  
**MINERALLAC**

- ★ Scissor Clips
- ★ Two-Piece Stud Clips
- ★ Min-A-Clips

Minerallac is the originator of the most complete and most imitated line of clips on the market today. Minerallac Clips are the answer to the problem of hanging fixtures, etc. on T-Bar Grid Ceilings—Bulb-T-Iron or Beams—and installing conduit, pipe, boxes and fixtures on "Poured Deck Type Roofs."



#### MINERALLAC SCISSOR CLIPS

For hanging fixtures, etc. on T-Bar Grid Ceilings. A two-piece clip for mounting fixtures, boxes or conduit hangers to a 1-inch T-Bar. Easy to install. Locks in place. Test loads over 100 lbs. Zinc plated steel.

#### MINERALLAC TWO-PIECE STUD CLIPS

For mounting boxes, hangers or fixtures to Bulb Tee Irons or Beams heavier than the 1-inch T-Bar. This clip will fit flanges 1 3/4" to 2 3/4" width and up to 3/8" thick. Test load over 100 lbs. Zinc plated steel.

#### MINERALLAC MIN-A-CLIPS

The most efficient and economical method for installing conduit or pipe on Bulb Tee Irons of "Poured Gypsum Deck Type Roofs". Hanger turns on rivet, eliminating many bends. Safe load 30 lbs. Zinc plated steel.

#### Exclusive Feature!

Each Minerallac fitting is "SIZE-MARKED". All are clearly and individually stamped with its exact size for immediate identification and quick and easy handling. Ends time-consuming guesswork and costly mismatches in the stock room and on the job.



Order from Your Electrical Wholesaler  
LITERATURE OR SAMPLE ON REQUEST

**MINERALLAC Electric COMPANY**  
ESTABLISHED 1894

25 N. PEORIA STREET • CHICAGO 7, ILLINOIS

(90) TRANSISTORIZED sensitive relay is described in Bulletin GPC-B49. General Electric Co.

(91) AUTOMATIC TRANSFER SWITCHES, magnetic contactors, special electromagnetic controls and timing devices for a wide range of applications in industrial plants, institutions, public buildings, air-fields, etc., are described in new 4-page Bulletin A-17. Zenith Electric Co.

(92) TWO-WAY RADIO. Tubed and transistorized VHF two-way radios in powers of 100 watts and less are featured in 24-page Bulletin ECR-904. General Electric Communication Products Dept.

(93) ELECTRICAL and lubricating devices are described in 12-page Catalog No. 61. Trico Fuse Mfg. Co.

(94) CONTROL SYSTEMS. A complete line of equipment designed to provide automatic temperature control of all damper-controlled air conditioning classroom unit ventilators is described in Bulletin F-10151-1. Barber-Colman Co.

(95) FOOTBALL FLOODLIGHTING is described in new special manual containing specifications and installation data. Benjamin Div., Thomas Industries Inc.

(96) HIGH TEMPERATURE WIRES, cables, tubings, etc. are described in new 58-page catalog. Hitemp Wires Co., Div. of Simplex Wire & Cable Co.

(97) POWER SUPPLIES. 44-page catalog covers complete line of both standard and custom engineered power supplies, ranging in size from 50 watts to 5,000 kilowatts. American Rectifier Corp.

(98) NOISE CONTROL. 16-page booklet "The Why and How of Noise Control" discusses fundamentals of industrial noise control. H. H. Scott, Inc.

(99) AREA LIGHTING Designer's and Buyer's Guide, Bulletin GEA-7223, 30 pages, describes complete area lighting line with eight new products. General Electric Co.

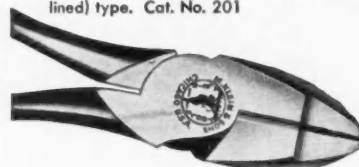
(100) NETWORK TRANSFORMERS, 5 kv through 15 kv with oil or non-inflammable liquid (vault and subway type), are described in 8-page Bulletin CS-601. Kuhlman Electric Co.

# KLEINS

for LINEMEN  
and ELECTRICIANS



**The Original Klein Side Cutting Plier**—Also available in NE (Stream-lined) type. Cat. No. 201



**High Leverage Plier**—Extra high leverage permits cutting extremely tough wire. Also available in the standard type as shown above. Cat. No. 213-9NE



**High Leverage Oblique Cutting Plier**—A recently introduced plier designed to cut toughest wire. Cat. No. 228-8



**Electrician Conduit Plier**—Reams inside and outside of conduit, tightens lock nuts in outlet boxes. Cat. No. 333-8

"Since 1857" the name Klein has stood for the finest in tools and equipment for linemen and electricians. It is the uncompromising high quality back of the name Klein that has won Klein Pliers their place in the hands of men who know good tools. Klein Pliers are now available in a wider variety of styles and sizes than ever before. Be sure the pliers you need carry the Klein trade-mark.



**Klein Catalog Free**—This new Klein catalog giving complete information on Klein tools and equipment for linemen and electricians will be sent on request. Write for your copy.

**Ask Your Supplier**—Foreign Distributor:  
International Standard Electric Corp., N.Y.

Mathias **KLEIN** & Sons  
Established 1857  
7200 McCormick Road • CHICAGO 45, ILLINOIS



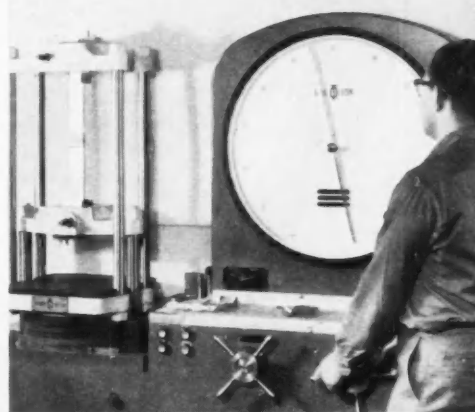
### **It happens every day**

Design and performance at ERICO are not chance happenings. Twenty years of experience enable us to give our customers the most efficient and economical electrical connections — CADWELD.

Your particular application is laboratory tested for: corrosion resistance, conductivity and strength to insure 100% efficiency.

**CADWELD ELECTRICAL CONNECTIONS**  
**Erico Products, Inc.**

2070 E. 61st Place • Cleveland 3, Ohio  
IN CANADA: contact ERICO INCORPORATED  
7 Superior Ave. • Toronto 14, Ontario, Canada



ST. WHITFORD

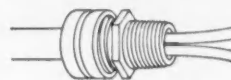
#### SPECIFICATIONS

Tapered conduit threads guarantee a strong, rigid, water and oil tight joint.

Tapered rubber grommet with anti-friction washer provide a permanent tight sealing grip on outer jacket of cable.

Aluminum nut and body insure corrosion resistance and high lustre finish.

Sizes: most complete range of sizes from  $\frac{1}{4}$ " to 3" conduit and  $\frac{1}{8}$ " to 2 $\frac{3}{4}$ " cable.



### IF YOU NEED A CORD GRIP—SPECIFY PYLE

The purpose of a cord grip is to protect your equipment, instruments and appliances by sealing out oil, dust and moisture . . . to prevent cord failures by preventing pull-outs.

PYLE CORD GRIPS perform these jobs measurably better! Precision machined aluminum nut and body assure continuous corrosion-free protection, maximum mechanical strength, outstanding appearance. The rubber grommet, specially compounded and molded by Pyle, will not age harden—adds many more years to the life of your product. Want proof? Write for catalog.

*you can measure the difference*



THE PYLE-NATIONAL COMPANY, 1344 N. KOSTNER, CHICAGO 51, ILLINOIS



# Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

## Receptacle Ratings

**QUESTION L40**—An associate claims that a duplex receptacle rated at 15 amps, 125 volts, can be used to supply power to two 15-amp circuits through the two plug caps inserted into the duplex receptacle. I maintain that the receptacle is rated at 15 amps, and that the total current that can be drawn from it is 15 amps and not 30 amps. Who is correct?—J.A.M.

**ANSWER TO L40**—The way this question is worded, both men are correct in their approach.

A duplex receptacle rated at 15 amps, 125 volts can be used to supply power to two 15-amp circuits. However the duplex receptacle must be of a type which can be arranged and wired for separate feeds, or incorporates a break-off feature which will permit two 15-amp branch circuits to be connected thereto.

When a duplex receptacle is rated at 15 amps and is used in the conventional manner, the current is limited by the branch-circuit protection, and it would not be possible to carry 30 amps.—L.K.

**ANSWER TO L40**—From your description, you seem to be referring to a "split-bus" duplex receptacle where each half of the receptacle is rated at 15 amps, 125 volts. With such a receptacle it is perfectly proper to install two 15-amp branch circuits, connecting one circuit to each half of the receptacle. This is the same as using two 15-amp single receptacles of the "interchangeable type" on the same mounting strap. The conventional, solidly bussed duplex receptacle, rated at 15 amps, cannot carry a total load of more than 15 amps; and in some instances, the load should not exceed 12 amps as indicated in the last paragraph of Section 210-21 (b) of the NEC. In no case can 15-amp rated receptacles be connected to branch circuits larger than 20 amps.

Many 15-amp, 125-volt duplex receptacles available today contain a break-off feature in the center of the terminal busbars. This makes it possible to connect both receptacle outlets to the same 15-amp branch

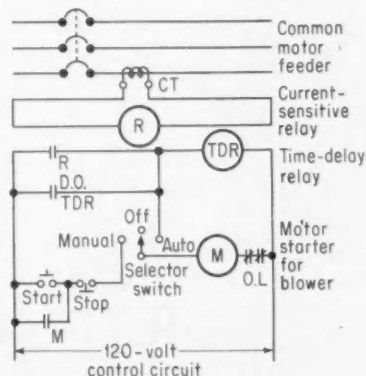
circuit. By removing the jumper, however, each half of the split receptacle can be connected to separate 15-amp circuits. Thus the answer depends on whether one or two circuits are involved.—H.J.B.

## Controlling Exhaust Blowers

**QUESTION M40**—In our grinding department we have several 550-volt motors on the same feeder, but all are individually controlled. Motors range in size  $\frac{1}{2}$  hp. to 3 hp. We would like to have an exhaust blower run every time anyone of these machines are started. These motors are spread out, so it would not be practical to have a separate contactor plus the extra wiring involved to accomplish this in the conventional way.—E.M.

**ANSWER TO M40**—There are several practical solutions possible to your problem. You did not state the size of the blower motor, but if the blower is not too big and the heat loss due to the exhaustion of the air is not too great, why not just leave the blower on during the working shift. This may be preferable to many starts and stops.

Another approach is the use of a current-sensitive relay wired across a shunt. This relay in turn actuates the starter of the blower. A refinement would be a time-delay relay which would let the fan run another five minutes or so after the tool is turned off. This would also prevent too frequent restarting as this time delay most likely will "carry over," when another tool is started up soon after the first one is turned off.

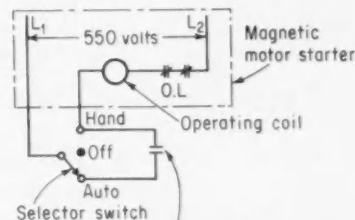


Several types of cheap relays suggest themselves. Using a CT instead of a SHUNT allows using relays in the 120-volt range, while otherwise your local inspector may require double-voltage relays to separate the 550-volt circuits. If, of course, your blower motor starter is 550 volts no such problem arises provided the timer—if any—has the same rating. (See sketch for one simple way of wiring.)

A third possibility is an electronic switch which is noise actuated. Assuming the noise level rises considerably when a tool is put into operation. Every electronic student can build one for a few dollars.—K.H.

**ANSWER TO M40**—Automatic control for this blower motor can be accomplished in several different ways.

A. With a normally open auxiliary contact at each grinder motor starter. Connect as shown on diagram.



Normally open initiating contact.

"A" All auxiliary contacts in grinder motor starters connected in parallel.

"B" Contact of current-sensitive relay.

"C" Contact of dust detecting device.

B. With a current-sensitive relay connected into one phase of the feeder to the grinder motors. All grinder motors, but no other load, shall be connected to this feeder.

C. With one or more dust-detecting devices installed in the shop.

In method "A" and "B" the blower would be running whenever one of the grinder motors is running. In method "C" adjustable and preselected degrees of air pollution will control the operation of the blower motor. There are several manufacturers specializing in air pollution detecting devices.

If the rating of the initiating contacts is insufficient, a 550/110-volt control transformer or an auxiliary relay should be added.—J.A.



## Electrical Protection goes MODERN with BUSS Fuses...

*in the Village Shopping Center,  
Davenport, Iowa*

When the engineering firm of Booth Brothers laid out the electrical system for the Village Shopping Center,—it was determined that available fault currents could possibly exceed 70,000 amperes.

With faults of this magnitude available, safety demanded the use of superior protective devices.

So, the main service entrances are equipped with BUSS Hi-Cap fuses which have an interrupting rating of 200,000 amps. rms symmetrical.

Distribution panels are protected by FUSETRON dual-element fuses which have an interrupting rating of 100,000 amps. rms symmetrical.

To help guard against motor burnouts, small motors are protected

individually by Buss FUSTAT (type S) fuses.

In addition to providing the safest protection for the Village Shopping Center, BUSS and FUSETRON fuses help prevent unnecessary interruptions in electrical service because they are made to protect, not to blow needlessly.

### **With BUSS and FUSETRON FUSES SAFE PROTECTION REMAINS SAFE**

BUSS Hi-Cap and FUSETRON fuses will always provide the same safe, accurate protection even if called upon to open after years of inactivity, as they would on the day installed. Dust, fumes, corrosion or age cannot increase the capacity of fuses or lengthen their blowing time.

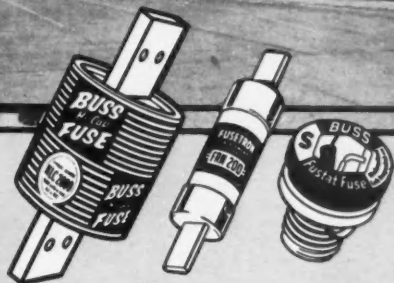
**ANOTHER BUSS AND FUSETRON FUSE INSTALLATION**



Architect and Owner: QUAD CITIES SHOPPING CENTER, INC.  
Davenport, Iowa

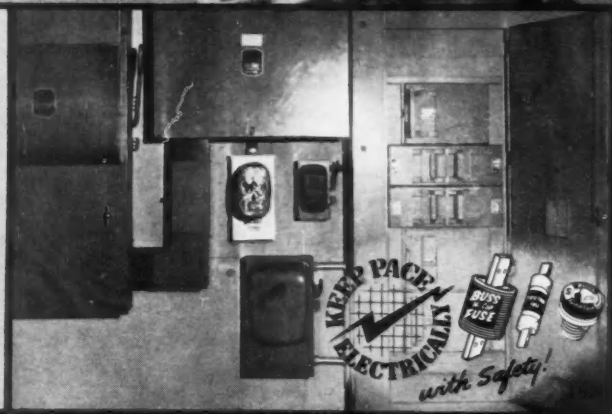
Consulting Project Engineer: BOOTH BROTHERS & CO., INC.  
Davenport, Iowa

Electrical Contractor: DELIVERY ELECTRIC, INC.  
Davenport, Iowa



for more information on...

Buss FUSTAT Fuses...  
write for Bulletins SCPS and SMPS  
FUSETRON dual-element Fuses...  
write for Bulletin FIS  
Buss Hi-Cap Fuses...  
write for Bulletin HCS



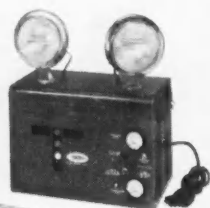
**BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.**





No. 700A—2000 ft. beam  
• Large and small bulb •  
Four No. 6 batteries\*

No. 2-FA—  
Automatic  
fast charge  
emergency  
light •  
Lead acid  
or nickel  
cadmium  
battery •  
Manual fast  
charge units  
available\*



No. 408F—Steady or flash-  
ing flare • Also transistorized  
models\*



No. 1711C—POWERHOUSE  
• 2000 ft. beam • 2 bulbs •  
Clamps on 7 1/2 V. battery\*

## Big Beam

Lights the Way to a Better Job  
Powerful BIG BEAM hand lamps,  
flares and emergency lights fit every  
requirement! Finest quality . . .  
American made.

\*WRITE FOR CATALOG  
on lamps and accessories

U-C-LITE Mfg. Co. 1035 W. Hubbard St.  
Chicago 22, Ill.  
Canada: Bernard Marks & Co., 32 Alcorn, Toronto 7



No. 164—1500 ft. ray •  
Sealed beam bulb and red  
flasher\*



No. 1000—Most powerful—  
2500 ft. beam • 2 bulbs •  
9 V. battery\*



No. 2-75—  
LIFESAVER  
• Low-cost  
emergency  
light • Dry  
cell battery  
• 5 hours  
continuous  
operation\*



No. 211—1500 ft. beam •  
2 bulbs • Two 6 V. batteries,  
one as spare\*

## SHERMAN TERMINAL LUGS AND CRIMPING TOOLS

SPEED INSTALLATION - REDUCE COSTS!

INDENTED CRIMP  
FOR GREATER RESISTANCE  
TO PULL-OUT



NOW  
AVAILABLE  
IN  
81 SIZES



VOID FREE  
CONNECTION



SHERMAN  
UNI-CRIMP  
LUG



SHERMAN  
'ST' LUG

### SHERMAN HAND CRIMPING TOOLS

Portable or bench mounted for fast, easy instal-  
lation of money-saving Sherman terminal lugs.

H. B. SHERMAN MANUFACTURING CO., BATTLE CREEK, MICHIGAN

## Can You Answer These QUESTIONS?

**QUESTION V40**—In the plant where I work, we have what is known as a tile machine on which we make ceiling tiles out of insulation fiberboard. On this machine we have some heating irons with which the bevel edges of this tile are seared. These heaters are constructed using two Chromalox tubular elements, each 675 watts, 230 volts in series and using 460 volts. Now the problem is, if one of these goes out the heating stops and causes cull tiles. The production engineer wants to put pilot lights on each heater so that if one of the heaters goes out, the pilot light will immediately let them know about it. These heaters have thermostats, and I have considered using a small contact thermostat set just under the bent of the heater thermostat so that if the iron cools a few degrees under that for which the heater thermostat is set for it will either turn a light off or on, whichever is desired.

Please let me know what your solution to this problem would be.  
—R.A.W.

**QUESTION W40**—We rewind many fractional hp split-phase stators with three leads. Is there any simple method to determine specific rotor rotation by checking polarities of starting and running windings and make final connections prior to dipping and baking the stators?—H.G.H.

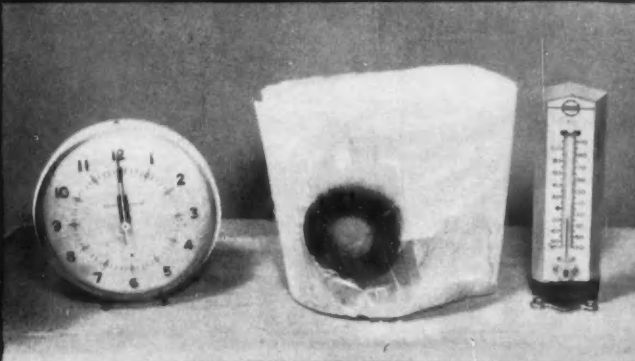
PLEASE SEND IN  
YOUR ANSWERS BY FEBRUARY 15



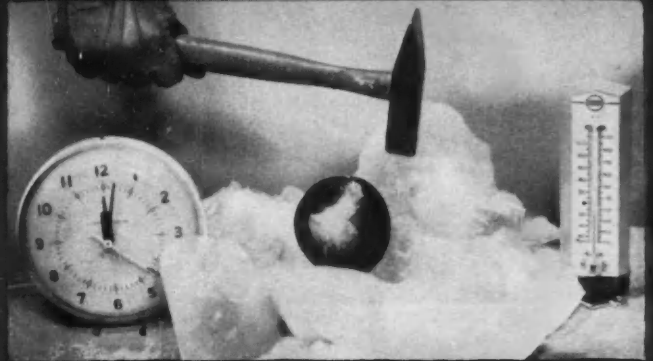
**STATE INSPECTION** problems are exchanged by Leo Nagel, Bismark, N. D.; and S. M. Sanford, Minneapolis, Minn., during break at Western Section, IAEI meeting in Oklahoma City. Both are on the State Electrical Boards of their respective states.



# WHEN IT'S COLD -THE SPLICE WILL HOLD WITH SLIPKNOT CW VINYL ELECTRICAL TAPE!



A roll of Slipknot CW is frozen solid in a block of ice at 14° F below zero.



Tape is broken out of ice . . .  
still at 14 below . . .



At 14° F below zero, this remarkable vinyl tape

- Strips easily from the roll . . .
- Remains completely flexible . . .
- Sticks down instantly — molds perfectly — holds permanently!

Try it in your home freezer  
— write for a sample roll  
on your letterhead today!



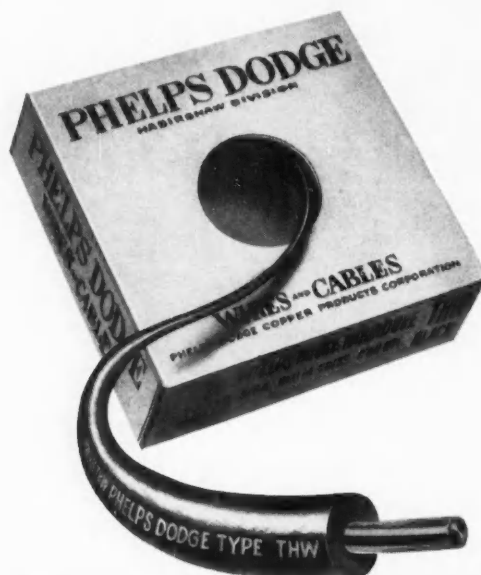
and in this frigid atmosphere remains completely flexible — strips perfectly from roll — even with ice still imbedded in the core.



35 seconds later perfectly conforming splice is made. Temperature . . . still 14° below!



PLYMOUTH RUBBER COMPANY, INC.  
QUALITY SINCE 1900 CANTON, MASSACHUSETTS



## Contractors prefer the advantages of **PHELPS DODGE** **THW** **WIRE**

**A 75C thermoplastic-insulated wire rated at 600 volts for wet or dry locations.**

The higher rating of Type THW wire offers important cost advantages as compared to Type TW. THW provides increased current carrying capacity in size 8 AWG and larger to accommodate higher power demands. When rewiring an overloaded TW system, THW wire may be installed in the same size conduit, permitting an easy, fast means of increasing capacity at minimum cost.

Type THW features include small diameter, smooth slippery finish, choice of colors and ease of stripping, factors that substantially reduce installation time. The all-around high quality of Phelps Dodge THW assures longer, safer, more efficient system performance.

Available in UL-approved sizes 14 AWG through 500 MCM.

See Your Phelps Dodge Distributor!

**PHELPS DODGE COPPER PRODUCTS**

CORPORATION • 300 PARK AVENUE, NEW YORK 22, N. Y.



**SALES OFFICES:** Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Des Moines, Detroit, Fort Wayne, Honolulu, Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Tampa, Washington, D. C.

# Questions on the Code

Answered by:

**R. L. LLOYD**, Electrical Safety Engineer, National Bureau of Standards, Washington, D. C.

**B. Z. SEGALL**, Consulting Electrical Engineer, New Orleans, La.

**R. E. WARD**, Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.

READERS are invited to submit questions regarding the National Electrical Code and its practical application to this Department. Questions are answered by the consulting editor whose initials appear at the end of each item. The views and opinions expressed are, in each instance, those of the individual consultant replying and are not necessarily those of his employers, of this publication or of a Code-making committee or panel on which he may serve in an official capacity.

## Branch-Circuit Conductor Size

**Q.** When derating factors of Article 310, and notes thereto are applicable, is it the intent of Section 210-19 that the conductors of the 15-, 20-, 30- and 50-amp branch circuits be increased to compensate for the decrease in conductor rating?—T.A.C.

**A.** Yes. It should be noted that Paragraph 210-19(a) requires the conductors to have a carrying capacity not less than:

1. the rating of the branch circuit, and
2. the maximum load to be served.

It should be further noted that in Section 210-3 the second sentence states "When conductors of higher capacity are used for any reason, the rating or setting of the specified overcurrent device shall determine the circuit classification." This recognizes the fact that for any branch circuit the conductors required may have current-carrying capacity in excess of the rating or setting of the specific overcurrent device. It must be remembered that the branch-circuit classification is based entirely on the maximum permitted rating or setting of this overcurrent device.

This overcurrent capacity of the branch-circuit conductors may be occasioned in general by two circuit conditions. It should be noted that Section 210-3 permits this "for any reason," but basically two definite circuit conditions require these higher capacity conductors.

First off, an exceptionally long branch-circuit run will require larger conductors to reduce the voltage drop in the circuit. Thus a 15-amp branch circuit, while normally requiring a minimum No. 14 Type RHW copper conductor, for example, would, for a 100-ft run branch circuit, require the use of a No. 12 or possibly a No. 10 conductor of a similar type so that the voltage drop can be kept to a

minimum. This is especially true for that section of the branch circuit usually referred to as the "home run."

Secondly, this problem of higher capacity is brought about when the normal current-carrying capacity of the conductor is reduced because of some derating factor. The most common one is the derating factor required for more than three conductors in a raceway or cable as per Note 8 to Tables 310-12 to 15.

For example, suppose a conduit contains three 3-wire, 120/240-volt single-phase branch circuits. This is a total of nine conductors. However, in each of these circuits there is one neutral, which for normal operating conditions carries only the unbalanced current from the phase conductors; and, therefore, in accordance with Note 11 to Tables 310-12 to 15, these are not included in the conductor count of Note 8.

We have then six current-carrying conductors, and this requires a derating to 80% of the normal current-carrying capacity of the conductors. Assuming further these are 20-amp branch circuits, the minimum size of conductor would be, for example, No. 12 Type R copper conductors. Since this conductor can only carry 80% of its capacity, it now has a rating of 0.8 x 20 or 16 amps. The minimum size of conductor would have to be capable of carrying 20/0.8 or 25 amps. Table 310-12 shows that we would have to install a No. 10 Type R for these 20-amp branch circuits.—B.Z.S.

## Motor Transfer Switch

**Q.** We have a 3-phase 50-hp motor installation to make in our plant. This motor drives a blower for circulating hot air in a furnace used in a manufacturing process. Should there be a power or motor failure during the time of processing the loss would be heavy. Therefore, it is necessary that every precaution be taken to assure unin-

terrupted service during processing. The power distributor will furnish two separate services to this installation with individual feeds from separate circuits, which will give two sources of supply to the blower and motor in question. Our plan is to install a double-throw manually operated switch of proper size and voltage for the purpose of switching from one source of supply to the other should a power failure occur on the service being used.

Will the installation of the double-throw switch when properly phased out meet code requirements?—W.G.T.

**A.** As far as I can determine from the National Electrical Code, there is no code provision that will prevent such an installation. This is more of an engineering question than of a code question. It is my understanding that double-throw switches are manufactured for such use, and the installation such as you describe should be acceptable.—R.E.W.

## Fixed Electric Heaters

**Q.** Can a 240-volt, 30-amp branch circuit be used to supply three 2000-watt fixed electric heaters, each of which has a built-in thermostat?—M.K.

**A.** Yes, Section 422-20, covering overcurrent protection, permits protection by the branch-circuit overcurrent device.

Under Paragraph 210-6(a) the voltage of branch circuits, in general, is limited only for lampholders, fixtures or standard receptacles rated 15 amps or less. The inference, therefore, is that branch circuits to appliances may have any voltage up to the general level of 600 volts.

In Paragraph 210-6(b) the voltage requirements for dwelling occupancies are specifically covered. Here in Exception No. 1, permission is definitely granted for supply



# NOW! INDIVIDUAL BALLAST PROTECTION IN EVERY\* FLUORESCENT LIGHTING FIXTURE

## Exclusive with Day-Brite

**...and it doesn't cost you a penny more!**

Individual ballast protection in every Day-Brite fixture is designed to prevent undesirable conditions which sometimes result at end of ballast life:

- prevents ballast smoking
- prevents ballast leakage
- prevents violent failure

At the first sign that such unusual conditions are developing, the ballast inside the Day-Brite fixture is immediately de-energized either by a temperature-sensitive system of thermal protectors built into each ballast or by a current-sensitive fuse built into the fixture. These protection measures are not affected by the temporary voltage or current surges that occur during normal lamp operation, thus assuring that you will have no "nuisance" outages. De-energizing

of the ballast takes place *only* when it has come to the end of its useful life and needs to be replaced.

**Other advantages of Day-Brite individual ballast protection:**

- Prevents unauthorized tampering because ballast control is located inside the fixture.
- Speeds up servicing by quickly identifying which fixture has the worn-out ballast.
- Other lighting fixtures on the branch circuit remain lighted during the ballast failure of one fixture because the ballast is de-energized before branch circuit fuse is affected.

For further information on individual ballast protection in Day-Brite fixtures, contact your Day-Brite representative listed in the Yellow Pages or write...

### **DAY-BRITE LIGHTING, INCORPORATED**

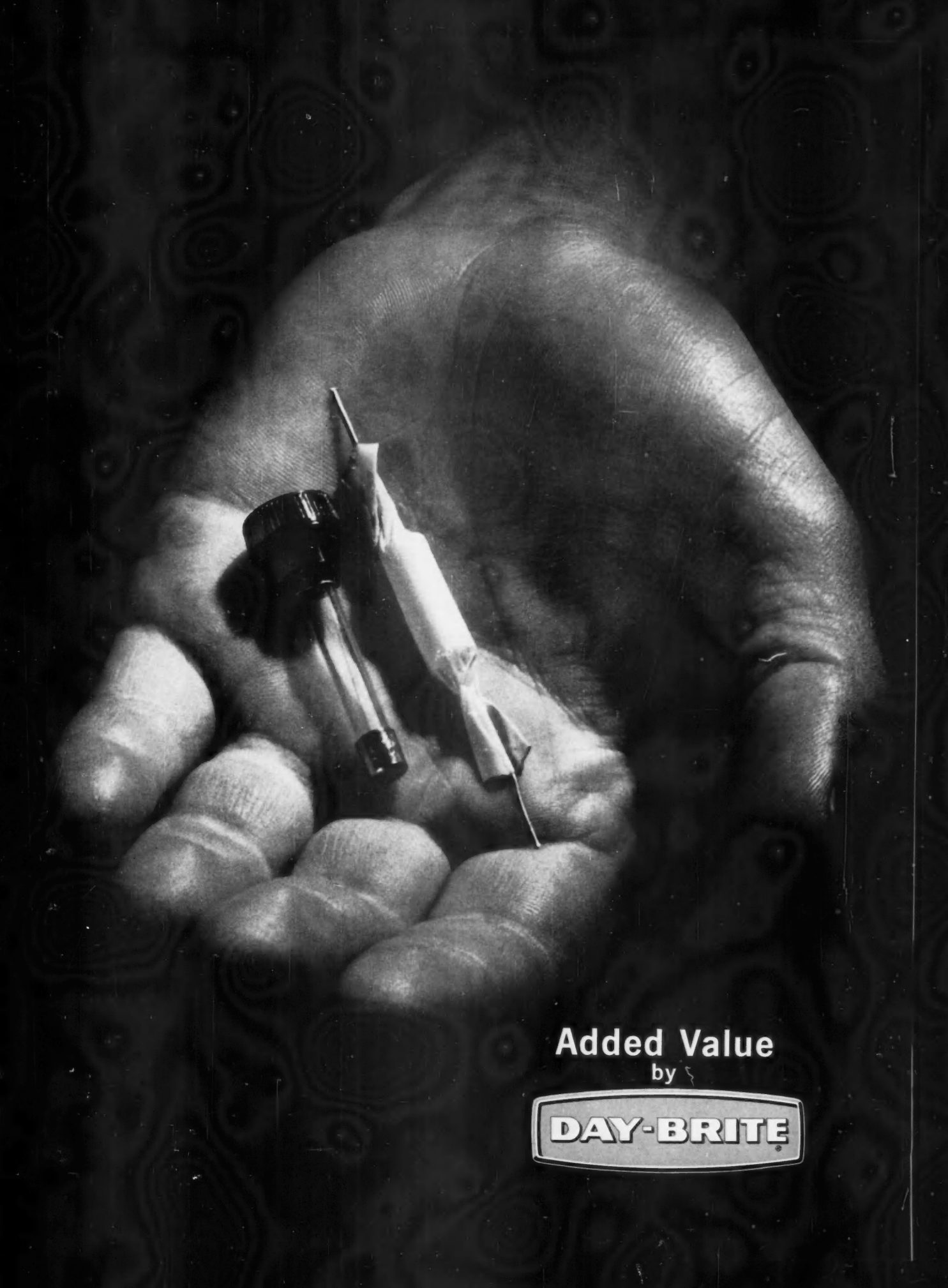
6260 North Broadway, St. Louis, Missouri, and Santa Clara, California. In Canada: Amalgamated Electric Corporation, Ltd., Toronto 6, Ontario.

**NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT**

See our catalog in Sweet's

\*Except EXIT SIGNS and NITE LIGHTS.



A black and white photograph of a hand, palm up, holding a cigarette and a pen. The hand is the central focus, with its fingers slightly curled. The cigarette is held between the thumb and index finger, and the pen is held between the middle and ring fingers. The background is dark and textured with a repeating circular pattern.

**Added Value**  
by

**DAY-BRITE**

# DURABILITY



The "SCOTCH" Brand Electrical Tape No. 33 used to wrap the cable on this portable welder provides excellent protection against wear and abrasion. Seals out dirt and moisture, provides an electrically sound insulation barrier that lasts for years. The cost of such durability? Only a few pennies. When tape costs so little, can you afford less than the best?

**BALANCED FORMULA IS THE SECRET:** Whatever the task, you can depend on "SCOTCH" Brand Electrical Tape No. 33. Its perfect balance of physical properties provides the ultimate in holding, protecting and insulating all in one wrap. Strong, stretchy, it has the perfect "feel" to get jobs done faster, done right. Tough vinyl backing shrugs off moisture, sunlight, heat, cold and other adverse conditions. Pressure-sensitive adhesive adheres instantly, holds permanently, without creeping or end-lifting. Low power-factor provides excellent insulation . . . high electric strength, wet or dry. For every job you can put your confidence in "SCOTCH" Brand Electrical Tape No. 33.

**FIRST and still the best**

MINNESOTA MINING AND MANUFACTURING COMPANY  
... WHERE RESEARCH IS THE KEY TO TOMORROW



"SCOTCH" is a  
Registered  
Trademark of 3M Co.,  
St. Paul 6, Minn.

to "permanently connected appliances" with branch circuits having a voltage between conductors exceeding 150 volts.

As to the ampere rating of the branch circuit in question, Paragraph 210-24(b) permits "appliances in any occupancy" to be installed on 30-amp branch circuits containing two or more outlets. And as indicated in the definition of "Appliance" in Article 100, this would include heating equipment. —B.Z.S.

## Fuses for 277-Volt Circuits

**Q.** Are 250-volt fuses acceptable for use on 277-volt lighting circuits?—R.S.

**A.** The voltage rating of a fuse represents the maximum voltage of a circuit on which it should be used. One of the fuse manufacturers has indicated that tests of 250-volt fuses on 277-volt short-circuit tests showed that many of the different makes of fuses would not perform acceptably. Therefore, the 250-volt rated fuse should not be used in 277-volt circuits.—R.L.L.

## Heating Cables

**Q.** Section 422-37 of the NEC, which refers to installation of heating cables in concrete or poured masonry floors, states in part: "(a) Adjacent runs of cable not exceeding 2½ watts per foot shall be installed not less than 1 in. on centers."

Does this prohibit the use of cable of higher wattage than 2½ watts per foot for use in concrete floors?—J.C.H.

**A.** Yes. This question is now before Panel 10 for revision. As noted in the Proposed Amendments, the Correlating Committee has requested its Chairman to appoint a subcommittee to study this problem.

At the present time there are many installations of cables in poured concrete being operated at wattages far in excess of 2½ watts per linear foot. In addition, there are now quite a few installations utilizing the re-enforcing rods within the concrete to furnish heating. Most of these are at low voltages averaging 20 volts.



# New **HUSKY** Ventrrib\*!

**The low cost cable-carrier, quality engineered with Husky experience**

The VENTRIB basket carrier is Husky's new, low cost addition to its growing line of cable support systems. Primarily designed to handle control cable, it is carefully pre-engineered for simple installation. Unusual slotted design provides maximum ventilation while permitting easy banding and/or clamping of cable. The overall corrugated VENTRIB design achieves optimum strength with a minimum of weight. Adhering to the highest standards of Husky workmanship and design, the VENTRIB basket carrier is supplemented by a full line of fittings and support materials.

Available in most popular industry sizes, VENTRIB is stocked for 24 hour shipment. For the latest word on this new Husky system, write for the VENTRIB catalog.

**HUSKY** - DIV. OF **BURNDY** CORP., 5300 VINE ST., CINN. 17, OHIO

**QIKLOK® Coupling**  
Secures Sections  
Sound mechanical  
joint with 3 prong  
coupling. Ease of  
installation saves  
time and money.



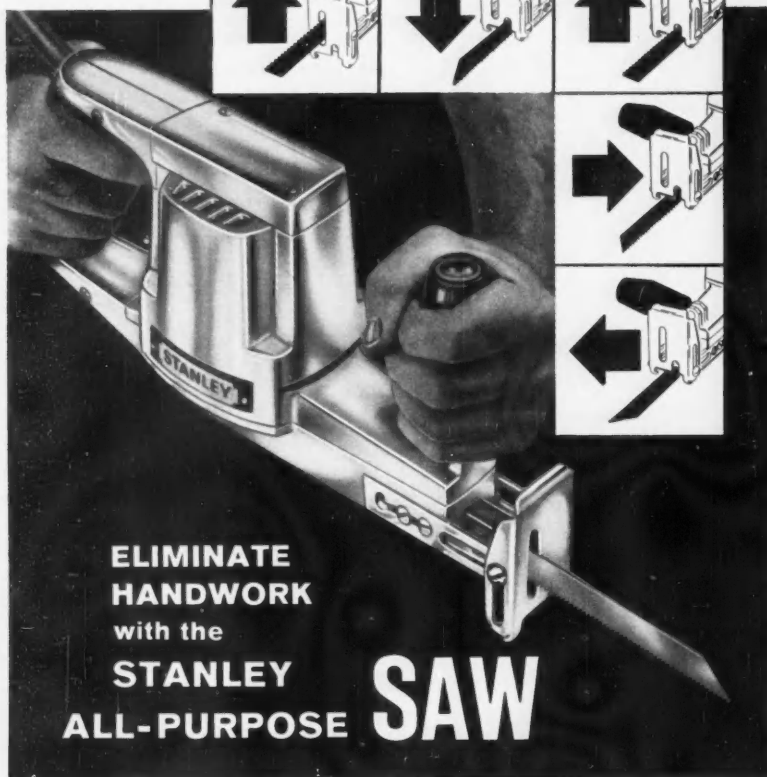
\*TM  
61-52



# CUTS FROM ANY ANGLE

# 6

## Saw Blade Positions!



**ELIMINATE  
HANDWORK  
with the  
STANLEY  
ALL-PURPOSE SAW**

Cuts flush to any surface, and flush with any surface to right or left . . . plunge cuts and does everything else you expect of a saw-of-all-work designed to handle every type of installation and maintenance sawing job.

**Two-Speed Control** increases accuracy of work and versatility of tool. HI speed for cutting through wood, plaster, nails, plastic and composition materials; LO speed for cutting wide range of metals.

Perfect balance and vibration-free operation mean more comfort, less fatigue and money saved by minimizing blade breakage.

See your Industrial Distributor, or write direct.

## STANLEY POWER TOOLS

# STANLEY

DIVISION OF THE STANLEY WORKS  
871 MYRTLE STREET  
NEW BRITAIN, CONNECTICUT

®

It should be emphasized, that in general, none of these systems are approved by the present code either because they exceed the 2½ watts limitation or their voltage operation may present a potential hazard.—B.Z.S.

## SE Cables as Feeders

**Q.** Can SE cable with a "covered" but not insulated neutral be used as a feeder in a building to supply a panelboard?—S.T.L.

**A.** As required by Section 338-3, all of the circuit conductors of the SE cable, when used as a feeder within a building, must be insulated. The "covered" but uninsulated conductor may be used as the grounding conductor and one of the insulated conductors may be painted white on the ends and used for the neutral. When used as feeder within a building, the uninsulated conductor is not suitable for use as the neutral conductor.—R.L.L.

## Wiring Methods

**Q.** Our county government is building a combination storage warehouse and school-bus garage to be used in connection with the county educational system. Storage space will be used for school lunch-room supplies, including foods, textbooks and school janitorial supplies. The garage will be large enough for work space to accommodate three large school busses at one time. The entire building will be one-story, split-level, with the warehouse and office space floor approximately 3 ft above the floor level of the garage, which will be at ground level. The warehouse and office space is raised for ease in loading and unloading of materials from a loading platform. The building will be masonry construction with wood-frame exposed roof structure.

What method of wiring will be required?—T.S.

**A.** From your description you have at least two or more classifications of occupancies in this building. First, the garage part is covered by Article 511 of the code, which subject is "Commercial Garages," and includes locations of service and repair of





## This plug's a workhorse

**pozi-grip\***.....O.Z.'s new plug design for all standard cable supports. Thousands of tiny but tough grippers are sealed into a special coating bonded to the plug's grooves. Increased gripping power is constant, even, and positive over the full

circumference of the cable. POZI-GRIP plugs surpass all UL requirements.

This is another quality step by O.Z. to bring you the best electrical fittings through a nationwide network of the finest electrical distributors.

\* Trade Name—Pat. Pending



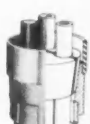
Type "S"



Type "V"



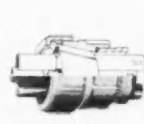
Type "D"



Type "C"



Type "R"



Type "K"



Type "M"



ELECTRICAL MANUFACTURING CO., INC.

262 Bond Street • Brooklyn 17, N. Y.

Sales Office and Warehouse: 406 So. Cicero Ave., Chicago 44, Ill. • ES 9-0326 • Office and Warehouse: 655 So. Van Ness Ave., San Francisco 2, Calif. • MA 1-4075  
Cast Boxes • Cable Terminators • Power Connectors • Solderless Connectors • Grounding Devices • Conduit Fittings • Interlocked Armor Cable Fittings

# ADVANCE In-warranty compensates the electrical contractor for

## ADVANCE IN-WARRANTY

The ADVANCE TRANSFORMER CO. **ILI** (In-warranty Labor Insurance) Program is designed to reimburse the Electrical Contractor for normal labor costs incurred in replacing ADVANCE In-warranty High Power Factor Fluorescent Lamp Ballasts.

**ILI** permits the Contractor to guarantee both labor and ballasts in fluorescent lighting installations. It gives fast and more efficient service for lighting equipment manufacturers' products if an ADVANCE Ballast becomes inoperative within the two-year warranty period.

The results of a recently conducted survey among NECA contractors were taken into consideration in the development of this program. The NECA members were sent a letter and questionnaire to determine an equitable cost for changing out inoperative Fluorescent Lamp Ballasts. The answers received varied, however, ADVANCE TRANSFORMER CO. took these variables into consideration to arrive at an average amount to be paid the contractor for changing out each in-warranty ADVANCE Fluorescent Lamp Ballast.

Remember, **ILI** is an exclusive program of ADVANCE TRANSFORMER CO. who brought the lighting industry Kool Koil Fluorescent Lamp Ballasts, ADVAN-guard, Thermally Protected Fluorescent Lamp Ballasts, Visa-Volt Color Coding, a Nation-Wide Service-Stocking Distributor Program and other important developments to meet the industry's changing needs.

## LABOR INSURANCE



Write today for complete literature on this ADVANCE In-warranty Labor Insurance **ILI** Program, another revolutionary benefit from the World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts.

# Labor Insurance Program

normal ballast replacement labor cost

## Here's how **ILI** works . . . . .

**1** The Electrical Contractor contacts his ADVANCE Representative when he experiences an ADVANCE in-warranty ballast failure. The ADVANCE Representative will qualify the job and issue an (In-warranty Labor Insurance) **ILI** number.



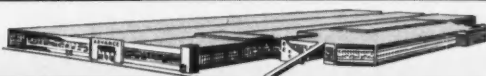
**2** The Electrical Contractor takes the in-operative ballast together with the (In-warranty Labor Insurance) **ILI** number to any ADVANCE Service-Stocking Distributor. The Distributor supplies the Contractor with new ADVANCE Ballasts at no charge and gives the Electrical Contractor an **ILI** form.

**3** The Contractor completes and sends the form to ADVANCE TRANSFORMER CO., 2950 N. Western Avenue, Chicago 18, Ill. He receives a non-negotiable check for replacement labor cost which will be redeemable in merchandise at any ADVANCE Service-Stocking Distributor.

WRITE FOR COMPLETE ILI BROCHURE



*"The Heart of the Lighting Industry"*



**ADVANCE**



WORLD'S LARGEST EXCLUSIVE  
MANUFACTURER OF  
FLUORESCENT LAMP BALLASTS



**TRANSFORMER CO.**

2950 NO. WESTERN AVE., CHICAGO 18, ILL. U.S.A.



# It's a Breeze ! Just a *Double Squeeze* Sets Up E. M. T.

*With Original B-M Indenter Fittings*



**Red Throat**

BM-21B  
1/2" Connector  
BM-22B  
3/4" Connector  
BM-23B  
1" Connector



**BM-41**

1/2" Coupling  
BM-42  
3/4" Coupling  
BM-43  
1" Coupling

BM-51  
1/2" Offset  
Connector  
BM-52  
3/4" Offset  
Connector

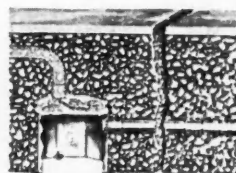


B-M Indenter Fittings and Tools make an unbeatable combination when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws. Other plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



B-M Offset Connector, showing how wires are guided over box edge.

Briegel All Steel Indenter Fittings are U.L. approved as Concrete-Tight.



# BRIEGEL

## METHOD TOOL CO. GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.



USED THE MOST FROM COAST TO COAST



## NEW SUBSCRIPTION APPLICATION CARD

YES SIR! I want to know the latest electrical estimating, wiring and maintenance methods! Enter my subscription to ELECTRICAL CONSTRUCTION & MAINTENANCE for a full year's service (13 helpful issues) for only \$3.

☐ Check here for two years at \$4 (You save \$2)

PLEASE PRINT

NAME .....	TITLE OR POSITION .....
ADDRESS <input type="checkbox"/> Home <input type="checkbox"/> Business .....	<div>Please do not write in this box.</div> <div>EC-</div> <div></div> <div></div> <div>M-</div>
CITY ..... ZONE ..... STATE .....	
CO. NAME .....	
OUR MAIN BUSINESS IS .....	
I am in charge of Electric Work <input type="checkbox"/> YES <input type="checkbox"/> NO	

Send No Money Now—Simply Mail Card Today!

EC-1-82

## NEW SUBSCRIPTION APPLICATION CARD

YES SIR! I want to know the latest electrical estimating, wiring and maintenance methods! Enter my subscription to ELECTRICAL CONSTRUCTION & MAINTENANCE for a full year's service (13 helpful issues) for only \$3.

☐ Check here for two years at \$4 (You save \$2)

PLEASE PRINT

NAME .....	TITLE OR POSITION .....
ADDRESS <input type="checkbox"/> Home <input type="checkbox"/> Business .....	<div>Please do not write in this box.</div> <div>EC-</div> <div></div> <div></div> <div>M-</div>
CITY ..... ZONE ..... STATE .....	
CO. NAME .....	
OUR MAIN BUSINESS IS .....	
I am in charge of Electric Work <input type="checkbox"/> YES <input type="checkbox"/> NO	

Send No Money Now—Simply Mail Card Today!

EC-1-82

FIRST CLASS  
PERMIT No. 64  
NEW YORK, N. Y.

**BUSINESS REPLY MAIL**

No Postage Stamp Necessary If Mailed In The United States

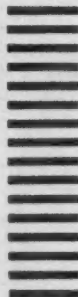
POSTAGE WILL BE PAID BY

McGRAW-HILL PUBLISHING CO., INC.

Electrical Construction & Maintenance

330 WEST 42nd STREET

NEW YORK 36, N. Y.



FIRST CLASS  
PERMIT No. 64  
NEW YORK, N. Y.

**BUSINESS REPLY MAIL**

No Postage Stamp Necessary If Mailed In The United States

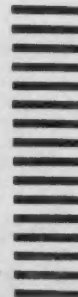
POSTAGE WILL BE PAID BY

McGRAW-HILL PUBLISHING CO., INC.

Electrical Construction & Maintenance

330 WEST 42nd STREET

NEW YORK 36, N. Y.



automobiles, busses, trucks, tractors, etc. In the garage area, if any wiring is below the 18 in. above floor level, this wiring would be a Class I, Div. 2 location; and if there is any pit or depression below the floor level, this would also be a hazardous location. In such areas classed as hazardous, the wiring and equipment shall conform to Article 501 of the code. All fixed wiring in spaces above the hazardous area shall be in metallic raceways or type MI cable.

With reference to the warehouse and office space, this classification will be according to Section 511-2(d), which reads:

"Adjacent areas in which hazardous vapors are not likely to be released such as stock rooms, switchboard rooms and other similar locations, having floors elevated at least 18 in. above adjacent garage floor, or separated therefrom by tight curbs or partitions at least 18 in. high, shall not be classed as hazardous."

Therefore, the wiring method in this part of the building can be other than metallic raceway or MI cable if such is not prohibited by local requirements.—R.E.W.

## Branch-Circuit Taps

**Q.** Can No. 14 conductors be used as thermostat runs, where several baseboard electric heaters are supplied from a 20-amp branch circuit?—C.R.D.

**A.** In Paragraph 210-19(c), Exception No. 2(b) limits the length of such taps to 18 in. To be applicable in this case, it must be assumed that the thermostat in question is directly connected into the branch-circuit conductors so that the thermostat runs are actually parts of the branch circuit. If the thermostat runs exceed 18 in. in length, the minimum size of conductor for these runs must be rated for at least 20 amps, so the No. 14 conductors could not be used. —B.Z.S.

## Wiring for Floodlight Trucks

**Q.** I have a grounding problem which may not be strictly in line with code enforcement but one which I am sure has confronted other electricians from time to time, and one which may involve the

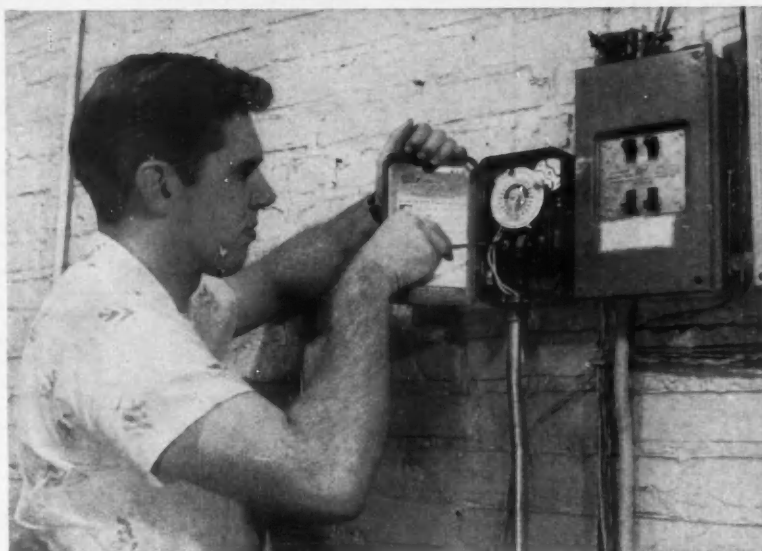
# ELECTRICAL CONTRACTOR

meets

# Intermatic

TIME SWITCHES

## Result: MORE DEPENDABILITY



It's the tough jobs that separate a quality product from an "also ran." That's why more and more Electrical Contractors are using Intermatic switches for every conceivable timing job. They count on engineered Intermatic reliability and accuracy for top-notch operation year in and year out under the most extreme conditions. Reliability that means more customer satisfaction and fewer call backs to save you time and money on every job!

### REASONS "WHY" INTERMATIC IS YOUR BEST BUY!

Snap-out mechanism for faster, easier mounting . . . 31 cubic inches of wiring space to work in without getting finger cramp . . . Top on the job performance with a heavy duty motor and 40 Amp rating (4375 watts tungsten rated) . . . Hi-Power switching mechanism and U-Beam Switch Blades assure long life . . . E-Z See Dial for faster, more accurate settings. It figures: Intermatic gives more switch for every dollar . . . more performance for every job.



UL and CSA APPROVED

For FREE illustrated color catalog  
MAIL THIS COUPON TODAY!

### OVER 100 MODELS TO CHOOSE FROM

- 125-250 Volts • 10 seconds to 23 hour timings • 1 to 96 operations per day • Up to 55 Amps • One or two circuits • Standard or "Skipper" models
- NEW ASTRONOMIC DIAL SERIES

#### INTERNATIONAL REGISTER COMPANY

2624 W. Washington Blvd., Chicago 12, Illinois

Gentlemen: Please send me your catalog on the complete Intermatic Time Switch line. Bulletin 12-8

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

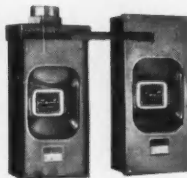
MY DISTRIBUTOR IS \_\_\_\_\_



## LOOK! a 200-amp breaker no bigger than this

Heinemann's SE-33 circuit breaker (shown actual size) needs only half the panelboard space of comparably-rated breakers. In an enclosure (indoor and outdoor types available), it's considerably smaller than a fused switch or pullout of equal rating. A two-pole breaker, the SE-33 is magnetically actuated—never has to be de-rated for high ambient temperatures. It accepts

copper or aluminum conductors in sizes from #6 to #250, CM, CU/AL, has pressure-type solderless connectors. Available in standard ratings of 125, 150, 175 and 200 amps, 120/240V AC. Priced advantageously. Bulletin 1003 will give you detailed information.



**HEINEMANN ELECTRIC COMPANY** ♦ 2606 BRUNSWICK PIKE, TRENTON 2, N. J.

2438

safety of persons handling equipment.

The question is this. In the wiring of fire department floodlight trucks, supplied by a single-phase, 115-volt motor-driven generator set mounted on or within the truck, is it proper to wire all outlets on the vehicle with a 2-wire system using 2-wire cords to supply the portable lamps without a common ground for the generator, truck frame or portable-lamp casings?

In my experience with floodlight trucks the 2-wire ungrounded system seems to be the accepted procedure; however, it has been suggested that a 3-wire system be used with 3-pole grounding receptacles, the third wire forming a common ground between generator frame and truck frame, thence to 3-wire portable cords, connecting the grounding wire to the portable-lamp casing.

While the truck and generator are mounted on rubber tires and are therefore isolated from the normal ground, it seems that it would be possible, if a ground occurred in the generator winding and a lamp casing at the same time, anyone carrying a portable lamp, connected by a cord to the truck, would receive a charge when making contact with the metal of the truck.—H.M.A.

**A.** Your interesting letter regarding the subject of grounding has been discussed with several qualified people, including the Chairman of Code Making Panel No. 5, and there is general agreement with your thoughts on the matter. As to the specific requirements of the NEC, Sections 250-3 through 250-5 discuss the grounding of systems. However, the grounding requirements apply only to systems that supply interior wiring. Section 445-8 requires that the frames of generators that operate over 150 volts to ground be grounded.

Some of the reasons for the preference of the ungrounded system in

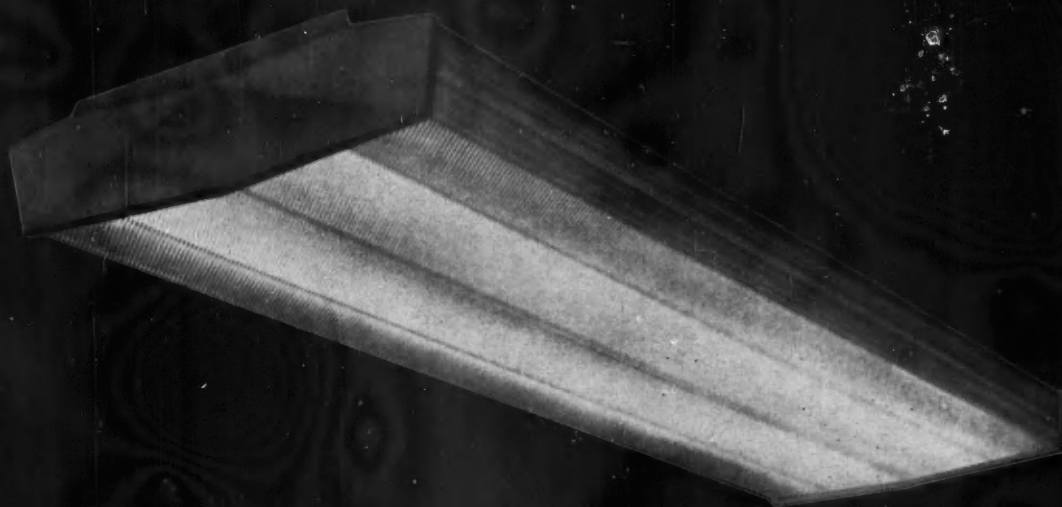


**REVIEWING NOTES** taken during Western Section, IAEI, conference in Oklahoma City are C. K. Barnes, Oklahoma Gas & Electric Co.; and Jack Crosland, electrical inspector, Fort Smith, Ark.

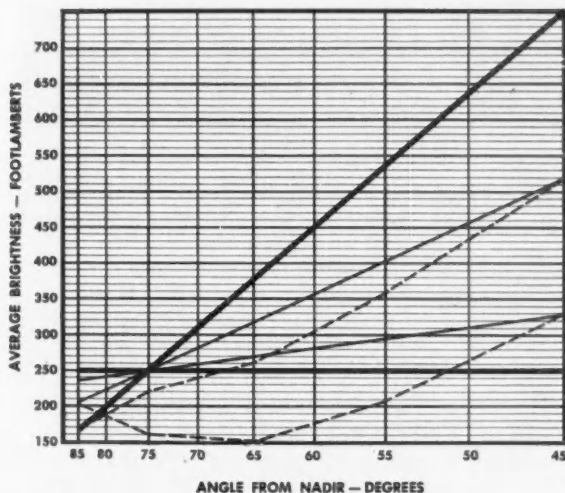


# LPI

## CRITERION



### New LPI Criterion meets I.E.S. visual comfort recommendations offering completely luminous shallow design



Visual comfort of the Criterion I series in the direct glare zone is depicted in accordance with the "scissors curve" method recommended by the Illuminating Engineering Society. The ratio of maximum brightness to average brightness is well within the recommended three-to-one limits for comfort at each angle. A complete photometric analysis by E.T.L. is available upon request.

When your lighting application calls for optimum visual comfort you can meet the need with the new Criterion I luminaire by LPI. It fully complies with I.E.S. recommendations for alleviating direct glare whether viewed crosswise or lengthwise in a room.

When your lighting application calls for higher foot-candle levels you can meet the need with LPI's Criterion II luminaire. This model provides higher coefficients of utilization than the Criterion I with excellent brightness control, but it is not designed to comply with the "scissors curve."

Both new LPI Criterion luminaires feature completely luminous design which adds to the attractiveness of modern schools, offices and stores with excellent brightness control. Criterion luminaires utilize lamps up to 3100 lumens and are available in two-lamp and four-lamp-tandem models. For complete information, write for LPI's Criterion bulletin.

LPI-1-300

Lighting Products Inc. Highland Park, Illinois

# LPI

## FLUORESCENT LIGHTING



## VAP-OIL-TITE CONNECTORS

- for use with liquid-tight flexible, metallic conduit
- absolute water and oil-tight seal — vapor, dust, grit can't penetrate



### STANDARD SIZES — ½" to 2"

Available in 3 styles — straight, 90° angle and 45° angle. U.L. and J.I.C. approved. Fit both EF and UA conduit. Seven sizes for each style from ½" to 2" conveniently packaged in lots of 5 to 100, or by carton...priced right!

### LARGE SIZES—2½", 3", 4"

Straight style only. Double O-ring neoprene seals prevent foreign matter penetration—**nothing can get through!** Extra long skirt prevents damage to conduit. Three sizes, 2½", 3" and 4" packaged individually — at the right price!



### EASIEST TO APPLY--NEVER PULL APART

The *only* completely reusable connectors for OEM, replacement and maintenance, and machinery applications where a positive seal against water and oil is a must!

WANT  
DETAILS?  
... send  
coupon  
NOW

IDEAL INDUSTRIES, Inc.  
1041-A Park Ave., Sycamore, Ill.

Send Vap-Oil-Tite Catalog data

Name

Company

Address

City  Zone  State



**NYBFU REPRESENTATIVES** R. D. Cranston, upstate supervisor, Buffalo, N. Y., and F. T. Waters, Auburn, N. Y., attended the lively code clinics at the recent IAEI Eastern Section meeting.

this instance are as follows:

First, with an ungrounded system, the only voltage to ground is of a capacitive nature, usually reading about one-half the line-to-line voltage. This, of course, will depend on circuit parameters.

With an ungrounded system, a line-to-ground fault in one conductor will not open the overcurrent protective device. The circuit will continue to function normally, merely grounding one leg of the system temporarily. This aspect seems to be important in view of the "emergency" nature of a floodlight truck, as one would not want all or part of the portable lighting units to be disconnected (which is what would happen in the case of a line-to-ground fault with a grounded system and equipment grounds).

Another item, not generally considered with the grounded system and equipment grounds, has to do with portable 3-wire cords. A grounding conductor in such a cord does not lessen shock hazard due to a frayed or damaged cord, which may expose a "live" conductor. It follows, then, that a person touching the live conductor could receive a fatal shock—something that would not normally occur if the system was ungrounded.

Finally, one must consider the infrequent use of the floodlight truck. This should afford ample time to check and repair the electrical equipment so that everything will be in order when its use is required. It is a very simple test to detect a ground or partial ground in any part of an ungrounded system.

On the basis of the foregoing statements, there is reason to believe that the ungrounded method is superior to the grounded method for the type and use of the equipment in question.

I would suggest that this matter be discussed with your local inspection authorities.—R.E.W.

**A Packaged Direct Mail Campaign for Electrical Contractors**

**"THE BEST IDEA YET  
FOR SELLING MORE  
HOUSEPOWER JOBS"**

TV star  
DOROTHY COLLINS  
endorses  
Full HOUSEPOWER  
sponsored by the  
National Wiring Bureau.

## New Packaged Direct Mail Boosts Rewiring Business

Direct mail goes direct to the homeowners you want to sell . . . delivers your selling messages to your best prospects.

This new packaged program requires none of your time . . . all the details are handled for you automatically. Includes six colorful mailings, personalized for you, with built-in prospect locator. Costs only pennies per prospect.

NATIONAL WIRING BUREAU • A SPONSOR OF  
**HOUSEPOWER**

Send in coupon below for complete information

National Wiring Bureau  
155 East 44 Street  
New York 17, N.Y.

Please send me full particulars on the new Packaged Direct Mail Campaign for electrical contractors. No obligation, of course.

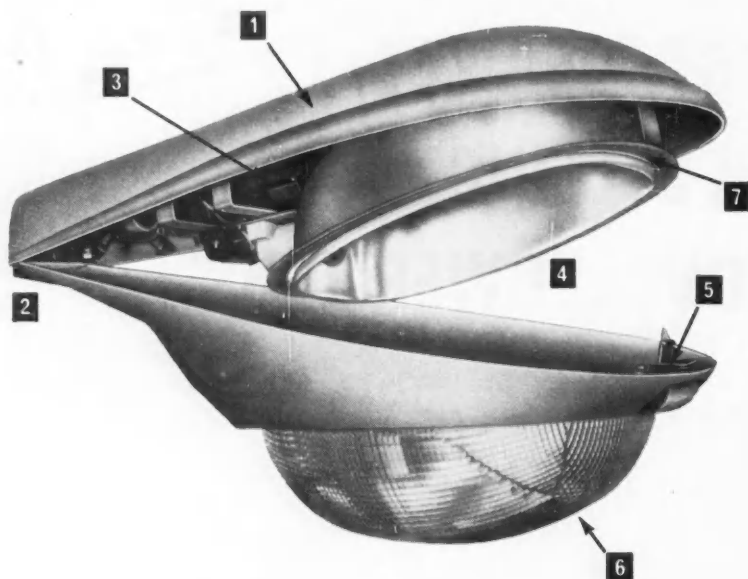
Name \_\_\_\_\_

Company \_\_\_\_\_

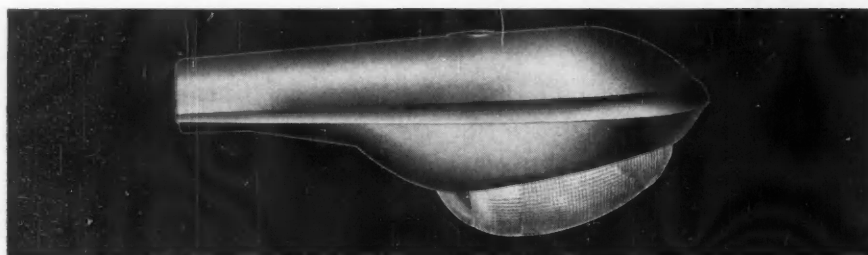
Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

ECM-12



- 1** Upper housing is one-piece, precision die-cast aluminum with reinforcing ribs and integrally cast universal slip fitter for 1½" or 2" pipe bracket.
- 2** Precision die-cast aluminum lower housing allows for natural expansion and contraction with temperature changes. A wide stainless steel hinge accurately positions housings for positive locking. A stainless steel latch prevents accidental disengagement of hinge during servicing.
- 3** Ballast components are arranged for efficient air cooling. Capacitors are mounted against contoured, heat-conducting pads.
- 4** Alzak-processed aluminum snap-in parabolic reflector is held by stainless steel spring latch. Socket is heavy-duty 20-amp mogul porcelain type with screw clamp pressure terminals. A heat-resistant molded silicone rubber socket gasket isolates reflector and ballast compartments.
- 5** Die-cast aluminum spring-loaded automatic latch assures proper alignment and locking of housings.
- 6** Refractor is molded of Corning's Pyrex® for maximum resistance to impact and thermal shock.
- 7** Optical system is completely sealed against moisture, insects, and dirt by a heat and moisture resistant silicone rubber gasket.



Series 2600 Endoval luminaire shown is one of several models available in Revere's "family" of mercury street lighting luminaires. It is available with or without built-in ballast components and adapter for photoelectric control. Uses 250 or 400-watt mercury lamps.

**Inside story of Revere  
street lighting luminaires  
shows built-in quality that  
delivers better lighting**

The quality features engineered into Revere's Series 2600 Endoval are typical of those to be found in Revere's other mercury luminaires, and are representative of the advanced design characteristic of all Revere lighting products. Such features assure easy installation and maintenance, trouble-free service, long life, and efficient performance.

For complete information on Revere Series 2600 Endoval mercury luminaires, including electrical characteristics and application data, write for Bulletin 700-15.

### **Revere® OUTDOOR LIGHTING EQUIPMENT**

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois  
(In Suburban Niles) Long Distance Phone: Area Code 312 Niles 7-6060  
Chicago Phone: SPing 4-1200 • Telegrams: WUX Niles

RVR-1-206



# In the News

## Electric Home Promotion to Emphasize Heating

In 1962 the heart of the Total Electric Home and of the Live Better Electrically Program is electric heating.

This was the word at the kick-off of the 1962 LBE program at a press conference November 30 in New York.

Albert V. Lowe, LBE program manager, presented details of the 1962 program, which included key advertising and promotion plans.

Going further into his statement about electric heating being the heart of the program, Lowe said, "We are proud to relate that over one million American homes are heated electrically today. . . . A giant step in the direction of the 5.2 million homes that will be electrically heated by 1970, and this figure is conservative."

Lowe pointed out that a recent nation-wide survey showed that 86% of homeowners interviewed are not only aware of electric heat, but eight out of ten say that electric heat is clean. "And cleanliness is the feature that our advertising has been featuring consistently and dramatically," he said.

An all-out promotion of electric heating by LBE will be 22 full-page heating ads in the *Saturday Evening Post*, *Life*, *Better Homes & Gardens*, and *American Home*. This is the beginning of a long-range program that, with the help of local utility promotions, will "far surpass that conservative 5.2 million forecast," Lowe said.

The launching pad for this campaign will be an eight-page, full-color insert in the February issue of *Reader's Digest*, featuring flameless electric heating and air conditioning.

Member utilities, manufacturers, and trade associations have ordered 1.2 million reprints, 3,080 dispenser boxes, and 2,570 banners.

The home builder is recognized as a "fundamentally important influence in our promotion of the total-electric concept," according to Lowe. "We have on hand a list of almost 6,000 significant builders who have recognized the tremendous competitive advantage of offering to their prospects the unequalled modern benefits of Living Better Electrically in a Total Elec-

tric Gold Medallion Home," Lowe said. "And the proof of this pudding is in their sales results, of which we have miles of taped interviews."

Builder testimonials are the nucleus of the builder advertising program represented by 14 black and white spreads scheduled for *House & Home* and the *NAHB Journal of Homebuilding* in 1962.

Four-color appliance ads, a series of 12, will appear in *Life*, *Saturday Evening Post*, *Better Homes & Gardens*, and *American Home*. These ads will feature ranges, water heaters, and dryers.

Even closer to LBE hearts is the Gold Medallion Home Program. This series of ads will feature the Total Electric Homes of families in all sections of the country, plus heating, appliances, lighting, and Housepower. Thirteen GMH ads will run in the same magazines as ranges, water heaters and dryers.

It is the utility tie-in advertising that makes the LBE Program complete. "We at Live Better Electrically, through our national efforts, build a bridge half-way across the river. In recognition of this fact, electric utilities will continue to run ads of their own that tie in with the major ideas and main themes of the national LBE Program," Lowe commented.

This will be supplemented by supporting advertising of manufacturers of electrical equipment.

The total program will spend \$52.5 million, \$2.5 million by LBE, and \$50 million from manufacturers and utilities.

Going back to the electric heating potential, Lowe pointed out that

there are 52 million homes in the U. S., and every one has used or will use electricity to some degree.

With one out of 50 homes having electric heating, it leaves 51 million without electric heating. Ten million homes have air conditioning, leaving 42 million prospects, according to Lowe. "Here is the big, big market for the future—Complete Electric Climate Conditioning."

He emphasized the potential of the market by stating that 1961 sales of electric heating equipment will total 5.5 million kw, and between 1961 and 1970 the potential is 20.4 million kw.

Also air conditioning sales this year should be 1,720,000 units, with a potential by 1970 of more than 20 million units.

## NEMA Group Hears Business Development Plans

At a meeting of the Generation, Transmission and Distribution Equipment Division of the National Electrical Manufacturers Association in Washington, D. C., on November 27 to 28, C. W. Mills, Westinghouse Electric Co., outlined the Association's business development programs.

NEMA's business development activities are aimed at selling appliances, lighting, electric heating, and many other products, he said, because the products of manufacturers, represented in the GT&DE Division are bought only in answer to a need created by customer purchases of electricity-consuming devices.

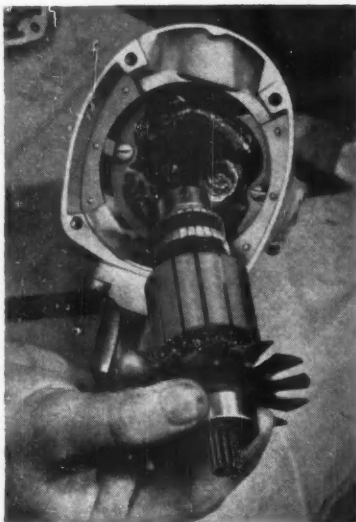
These activities are designed to supplement the programs of individual manufacturers, Mills continued, and they carry the message of electrification to the public and solicit the cooperation of utilities, contractors, and trade associations in programs of mutual benefit. These activities fall in four categories—residential, commercial, industrial and rural.

The residential market has two programs: (1) **HOUSEPOWER** to promote adequate wiring in existing and new homes; and (2) **Medallion Home** to promote total electrification in new homes. The commercial market has **Keep Pace Electrically** to promote adequate wiring, utilization equipment, and utility load in stores, offices, hotels,



**WITH CODE BOOK** as handy reference, Kansas electrical inspectors E. J. Fuller, Ellis; and E. L. Ganson, McPherson, get set for forum session at recent Western Section, IAEI meeting in Oklahoma City.

# BLACK & DECKER TOOLS FIXED



- ✓ FULL GUARANTEE on all recommended repairs
- ✓ NEW PRICE POLICY saves you money
- ✓ FAST REPAIRS in 24 hours or less
- ✓ GENUINE FACTORY PARTS made for your B&D tools
- ✓ ALL REPAIRS MADE by tool experts
- ✓ FREE REPAIR ESTIMATE on request

OVER 100 REPAIR CENTERS. Check the Yellow Pages under "Tools Electric" or write for address of nearest service station.



**JOINING THE RANKS** of Western Section, IAEI, past presidents, W. P. Hogan, Jr., Chicago, gets symbolic pin at recent Oklahoma City convention from senior past-president W. E. Stewart, St. Louis.

churches, and apartment houses. The industrial market is served by the Industrial Electrification Council which provides instruction on the application and benefits of electricity in factories.

All four programs are conducted in close cooperation with Edison Electric Institute, Mills added. And the fifth—the rural program—depends heavily upon EEI's farm promotion campaign, NEMA's contribution being certain booklets.

It is absolutely essential that NEMA receive public recognition for the programs it sponsors, Mills continued. To this end, the Business Development Committee has recommended distribution of a brochure telling members' customers how NEMA works to expand their markets.

"Give us full support in developing and implementing a program which will create understanding and appreciation of the work of NEMA and its member companies," requested T. A. Burdeshaw, Southern States, Inc.

Electric utilities and the manufacturers who supply them have for many years shown a persistent dedication to supplying better service to the public," he continued. Today's electric service could not have been attained without continuing research and effort by the manufacturers.

Despite this outstanding performance, relationships between the electrical industry and the public have deteriorated, Burdeshaw said. And this deterioration has extended to relationships between manufacturers and utilities. Many utility engineers today show a substantial lack of understanding of NEMA's purposes and activities. This, he said, is a "stinging indictment" of NEMA's members for failing to communicate with customers and their own employees.

The only way NEMA can be justified is through its contribution of greater efficiency to the production of goods and services, Burdeshaw continued. A more diligent effort must be made to improve the public's understanding of NEMA's purposes and achievements. NEMA's Public Relations Committee, he said, has developed:

1. A newsreel of the year's electrical highlights, suitable for television and industry meetings.
2. Posters for display in plants, schools, and other public locations.
3. Script for a 30-minute movie dramatizing the use of electrical equipment in many fields.
4. A basic speech with visual aids, for civic groups.

5. A plaque or medal to be awarded annually to member-company employees for contributions to community activities.

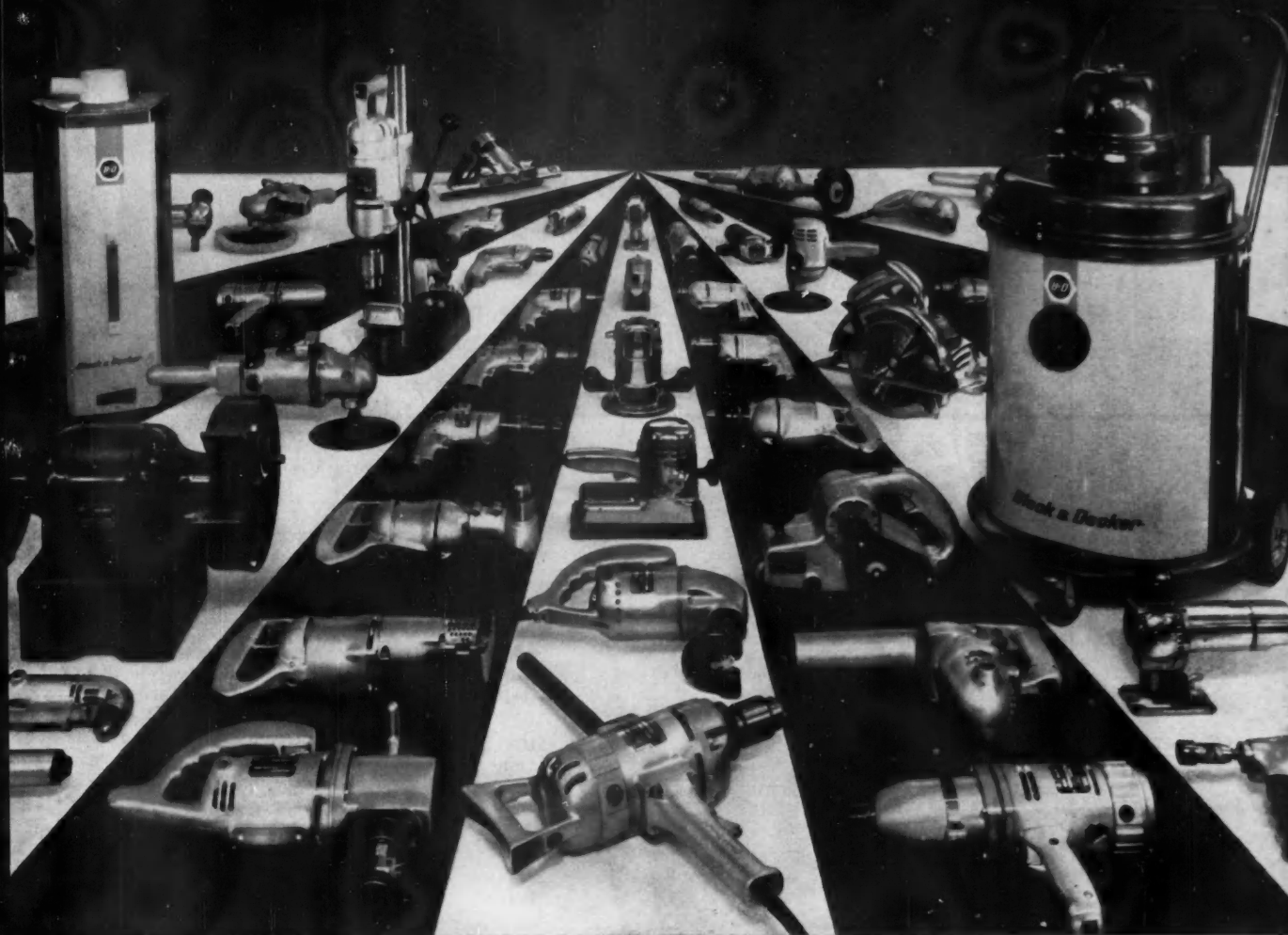
NEMA will no longer seek anonymity, said Managing Director J. F. Miller. It has stepped up its public relations budget 150%, redesigned its seal for greater impact, is opening a West Coast office, and will become more active in items not specifically electrical. But NEMA's activities must be of the sort better done by a trade association than by individual companies and, above all, must be legal, he said.

NEMA has had "a clean record" of compliance with antitrust laws, said Samuel W. Murphy, Jr., legal counsel. In terms set up by the Sherman Antitrust Act, a trade association is a combination. Accordingly, it must be most discreet in avoiding conspiracy or illegal contracts. He credited NEMA's policy of open membership, open records, and no price activities with keeping it out of trouble.

The GT&DE Division directors elected Louis J. Ott, Ohio Brass Co., chairman, to succeed C. H. Bartlett, Westinghouse Electric Co. J. F. Chipman, Allis-Chalmers Mfg. Co., was named vice chairman.



**RELAXING AFTER BUSY** code session at Western Section, IAEI conference in Oklahoma City are Clevelanders W. F. Walchli, code representative, Cleveland Illuminating Co., and Ray Zicarelli, city electrical inspector.



## Get your pick of power tools

... and service that never stops. Drilling, grinding, cutting, cleaning . . . Black & Decker's long line of power tools makes the distance shorter between the start and finish of any job. All told, there are over 130 B&D tools and more than 3000 B&D accessories . . . all sold by your Black & Decker distributor. He offers you continued service, too, a single source for all your power tool needs. Your paper-work costs are cut, transportation expenses trimmed and inventories lowered. You get quick catalog and price information, fast adjustments and swift satisfaction. Black & Decker tools are sold by leading distributors everywhere.

For sales or service, look in the Yellow Pages of your telephone book under...



# **Black & Decker®**

**CUTS MAN-HOURS TO MINUTES**

THE BLACK & DECKER MFG. CO., Dept. 1201  
Towson 4, Md. (In Canada: Brockville, Ont.)

- ☐ Please arrange for a demonstration of.....  
☐ Please send me more information on.....

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....



# SPECIFY MCGILL®

## PORTABLES FOR SAFETY, CONVENIENCE AND DURABILITY



THE QUALITY LINE



OVER 100 MODELS



**GROUNDING**

An extra margin of quality is built into the complete line of McGill industrial portable lamp guards for safe, dependable utility. Rugged, heavy duty construction and selected materials withstand the punishment of rough use.

More than 100 different types of McGill portable lamp guards have been developed to meet the particular requirements of a wide range of service conditions. Cages 50 to 200 watt, 660 watt, 250 volt sockets. Grounded, vapor-proof, double hook, reflector, concentrating end lens and many other optional features available. Most models also available with handles and cords in yellow—the accepted safety color.



No. 5100 — SRG grounded portable with 15 amp., 125V outlet.

Available from your Electrical Wholesaler



Write for McGill Electrical  
Specialties Catalog No. 84.

engineered electrical products

**MCGILL®**  
precision needle roller bearings

McGill Manufacturing Co., Inc., Electrical Div., 450 N. Campbell St., Valparaiso, Indiana



**EASA DIRECTORS** from the South discuss mutual problems at a recent meeting of the association's board in St. Louis. At left: Walter G. Brush, Electric Motor Service, Inc., Birmingham, Ala., and Carlton Andrews, Jones Electric Repair Co., Charlotte, N. C.

### EASA News

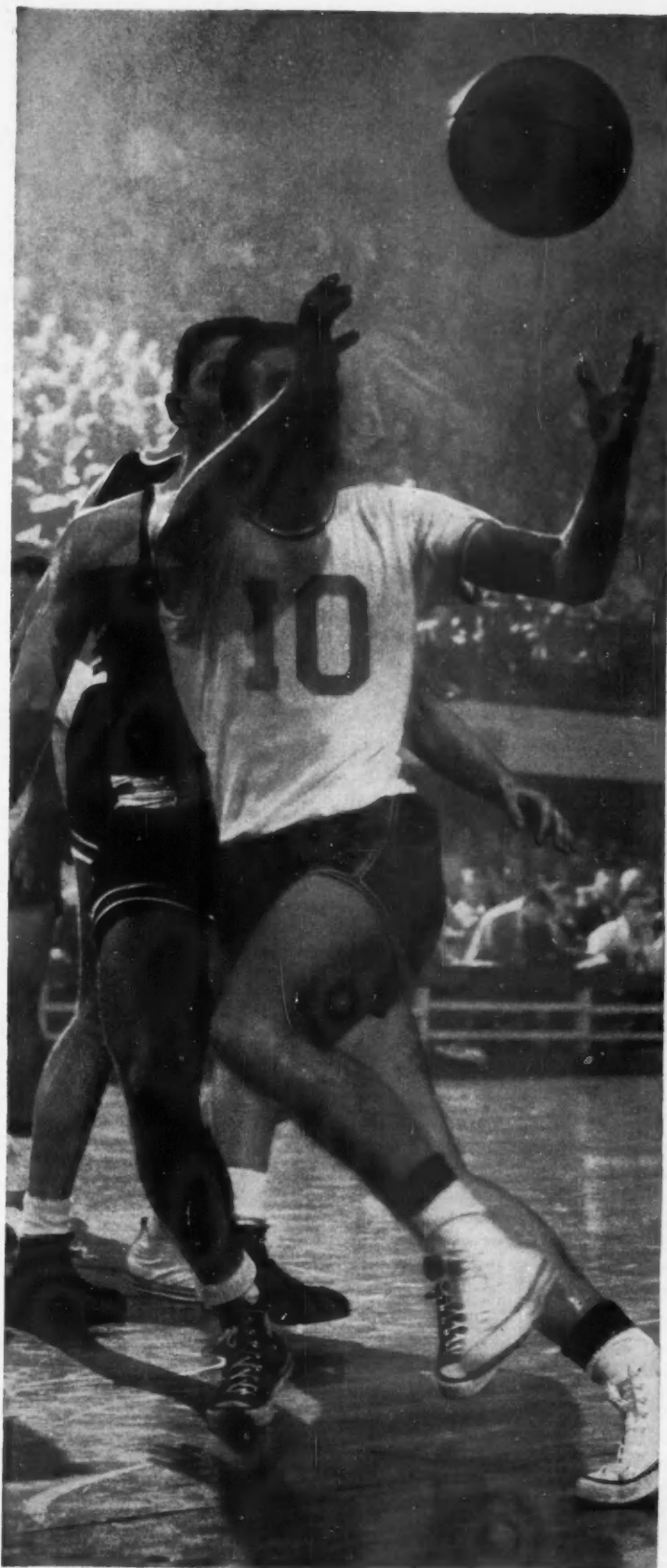
Reservations for the new series of Electronic Motor Control Courses are being accepted by EASA Headquarters in St. Louis, according to August A. Baechle, executive vice-president. The first of a series of basic, five-day courses will be held in Cleveland, Ohio, on January 8-12; with others scheduled in Houston, Texas, January 29-February 2; and in Seattle, Wash., February 12-16.

A second series of courses for advanced students will be held March 12-14 in New York City. Other three-day courses in this series are scheduled to be held in Chicago, April 9-11; Atlanta, Ga., April 23-25; Dallas, Texas, May 7-9; and San Francisco, Calif., May 21-23.

The rewinding of electrical apparatus rendered unusable by Hurricane Carla still goes on, according to Fred F. Fehrenkamp, Houston Industrial Supply Co., Houston, Texas. Mr. Fehrenkamp, who was in the thick of the post-Hurricane activity as supplier to many of the shops in the stricken area, said he believed it would be February or March before all the repairs had been made. One factory alone had 8,000 motors inundated.

James A. Phares, Southwest Electric Co., Oklahoma City, Okla., will take office as president of the Southwestern Chapter in March. Other new officers of the organization, one of the largest in the association, are: first vice-president, James M. Morgan, Fort Worth, Texas; second vice-president, Connie H. Henry Dallas, Texas; and secretary-treas-





## With Dodge's "fast break," you get into scoring position more often

Dodge helps electrical contractors get the jump on competition. With Dodge Reports you know about new construction bidding opportunities in your area first . . . *before* competitors who don't have this advantage.

Here's how: First, you tell Dodge the kind of jobs you *want*. Then, every day, Dodge Reports bring you advance information on just the type, size and location of jobs *you* specified.

With this headstart, you can be selective . . . you can go after jobs that look best to you, forget the ones you might otherwise have to take. To get the full details on Dodge Reports, return this coupon today.



**DODGE**  
reports

**ELECTRICAL CONTRACTORS!  
WRITE FOR FREE BOOKLET ►**

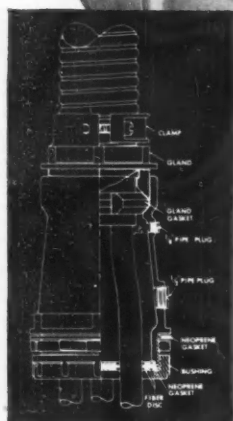
F. W. Dodge Corporation  
Construction News & Statistics  
Div., Dept. ECM12.  
119 W. 40th St., N. Y. 18, N. Y.

I'd like to receive your free booklet, "How Subcontractors Get More Work in New Construction" and details on how Dodge Reports can help me increase volume and profits.



Name \_\_\_\_\_  
Company \_\_\_\_\_ Title \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

PLM Type  
ACSW Terminator



*Wet locations?*

There's a **PLM**  
fitting to fit the job!

Terminating armored cable where a watertight cable entrance seal is needed? There's a PLM terminating fitting designed to fit the job—as there is to fit almost any other indoor or outdoor mounting requirement! The Type ACSW Terminator shown provides a compound-filled, watertight entrance seal in any position for jacketed armored cable. Variations available for non-jacketed. Other types meet needs for flange mounting on pothead bases or switchgear, or for angular, bracket or other special mounting.

PLM Terminating Fittings and Splicing Kits can speed up and simplify any cable installation or repair. Supplied for use with interlocked armored cable, non-metallic jacketed cable and lead-covered cable. PLM 52-page catalog 301 contain full description and prices. Write for copy on your letterhead.

**PLM** TERMINATING AND  
SPlicing ACCESSORIES  
*Products, Inc.*

3875 WEST 150th STREET • CLEVELAND 11, OHIO



**ATTENDING** his first board of directors' meeting of the Electrical Apparatus Service Association recently in St. Louis was Ivan G. Pixler, (left) Pixler Electric Co., Spencer, Iowa, shown with his predecessor, Thomas M. Paul, Paul Electric Co., Sioux City, Iowa.

urer, Woody Jackson, San Angelo, Texas.

The chapter plans to hold its spring meeting in Shreveport, La., on March 29-31 at the Captain Shreve Hotel.

Members of the Greater St. Louis Chapter of EASA toured the Electromotive Division of General Motors Corporation in St. Louis on November 29 preceded by a dinner meeting held at Holiday Inn.

Industrialist and investment executive Max A. Myers, Waddell & Reed, Inc., addressed the Quaker City Chapter of EASA on November 8 on the topic "Inflation, and What You Can Do About It." Mr. Myers' firm is the principal underwriter of United Funds, Inc. He previously was president of Scranton Glass Instrument Co.

The annual foremen's meeting of the New England Chapter will be at Hotel Sheraton in Worcester, Mass., March 17.

A record 35 prospective members attended the October meeting of EASA's Wisconsin Chapter, along with 60 members and associate members. The half-day affair, which included lunch and dinner at a Racine, Wis., restaurant, was sponsored by Badger Bearing Co., Complete Reading Electric Co., Delco Products Co., H. A. Holden, Inc., Manufacturers Specialty Co., and R. J. Wittenburg Co.

In Montgomery, Ala., the Mid-South Chapter held its quarterly meeting on December 1-2 at Holiday Inn Motel. Sixty-two attended to hear Major A. R. Jeffries, USAF, of Maxwell Field, discuss the American and Communist ideologies.

## DATES AHEAD

**Plant Engineering & Maintenance Show**—Convention Hall, Philadelphia, Pa., January 22-25.

**Power & Communications Controls Assn.**—17th annual convention, Atlanta-Biltmore Hotel, Atlanta, Ga., January 28-30.

**American Institute of Electric Engineers**—Winter general meeting, Statler-Hilton Hotel and Coliseum, New York, N. Y., January 28-February 2.

**Electrical Engineering Exposition**—Sponsored by AIEE, New York Coliseum, New York, N. Y., January 29-February 2.

**American Society of Heating, Refrigeration & Air Conditioning Engineers Inc.**—Semiannual meeting, Chase Park Plaza Hotel, St. Louis, Mo., January 29-February 1; 69th annual meeting, Deauville Hotel, Miami Beach, Fla., June 25-27.

**Home Improvement Products Show**—Cobo Hall, Detroit, Mich., January 31-February 2.

**International Association of Electrical Inspectors**—Chapter Meetings—Illinois, Morrison Hotel, Chicago, Ill., February 1-2; Mississippi, Heidelberg Hotel, Jackson, Miss., March 5-6; Ellis Cannady, Carolina Hotel, Raleigh, N. C., April 10-11; South Carolina, Andrew Jackson Hotel, Rock Hill, S. C., April 16-17; Georgia, Wanderer Motel, Brunswick, Ga., April 19-20; Alabama, Stafford Hotel, Tuscaloosa, Ala., April 23-24; **Five Chapter Joint Meeting**, Captain Shreve Hotel, Shreveport, La., April 26-28; Tennessee, April 30-May 1; Florida, Jack Tar Harrison Hotel, Clearwater, Fla., May 4-5; Virginia, Hotel John Marshall, Richmond, Va., June 18-19; **Southern Section**, Tutwiler Hotel, Birmingham, Ala., October 15-17.

**National Industrial Electric Heating Conference**—Netherland-Hilton Hotel, Cincinnati, Ohio, February 5-8.

**Intermountain Electrical Assn.**—Annual conference, Salt Lake City, Utah, February 8.

**National Electrical Week**—National Promotion, February 11-17.

**Air Conditioning, Heating and Refrigeration Industry**—12th exposition, Great Western Exhibit Center, Los Angeles, Calif., February 12-15.

**Upper Midwest Electrical Industry Convention**—Radisson Hotel and Municipal Aud., Minneapolis, Minn., February 18-21.

**National Conference on Application of Electrical Insulation**—Shoreham Hotel, Washington, D.C., February 19-21.

**18th Annual National Wiring Sales Conference**—Atlanta-Biltmore Hotel, Atlanta, Ga., February 22-23.

**Sacramento Valley Electrical League**—Progress in Electrical Equipment Exhibit, Sacramento Inn, Sacramento, Calif., February 28-March 2.

**National Rural Electric Cooperative Assn.**—20th annual meeting, Convention Hall, Atlantic City, N. J., March 5-8.

## Rules and Regulations Relating to the Use of Submersible Lighting for Swimming Pools, Reflector Pools and Display Fountains.

### Bulletin No. 17

**17.1 General**—Effective as of this date, the use of 120-volt lamps when assembled in submersible lighting units, for the illumination of swimming pools, reflector pools or display fountains, whether they are intended for side wall or pedestal mounting, is hereby prohibited.

**17.2 Voltage**—The permissible voltage that may be applied to lamps used for such application shall not exceed 12 volts.

**17.3 Transformers**—a. Step-down transformers used in conjunction with such lighting units shall be of the two-winding, isolating type and having a grounded metallic shield between the primary and secondary windings to prevent accidental contact between windings under fault conditions. b. Transformers shall be located remotely from the lighting units which they supply, and over-current protection shall be provided in both primary and secondary windings.

**17.4 Swimming pools, reflector pools, or display fountains presently under construction**



## LIFESAVER

Underwater lighting is serious business.

Deadly serious.

Cutting corners can cost lives.

Precisely why the Stonco line is solid cast bronze. Porosity-tested. With a special low voltage transformer for safety plus.

(We've tamed the high voltage. Isolated it with a grounded shield that stops cross-over from primary to secondary. Harnessed it with a fuse factory-sealed to guard against do-it-yourself electricians.)

Even the deck box is gasketed watertight fore and aft. Keeps wiring bone dry. From surface slop, seeping water, or pool overflow caused by flash floods.

No wonder Stonco submarine lighting meets all the safety codes.

Incidentally, even our fountain lights are available low voltage.

Fish have to live too.

# STONCO

*lighting*





**JET LINE**  
**Jetmaster**

**JET LINE CYLINDER**  
For use in all 1/2", 3/4", 1" conduit

**JET LINE GUN**  
for use in all conduit 1 1/4" through 4"

**JET LINE POLY ROPE**  
—500 ft. and reel

**JET LINE POWER UNIT**  
20 lbs. CO<sub>2</sub> power for operation of tools

**JET LINE RIGID ROPE**  
Use to fish conduit safer, easier

**JET LINE UNDERGROUND**  
To install pull line in conduit 1 1/4" and up

**CATALOG NO. 1210**  
\*Jet Line Gun method and apparatus covered by basic patent No. 2,930,584

**Here's the all-new Jetmaster—combining the entire Jet Line Method® into one handy, compact, easily portable unit! On any wire pulling job, with Jetmaster you'll have all the Jet Line tools, accessories and power you need—right at your fingertips. Jetmaster saves countless hours (and dollars), helps you pull wire quickly, easily, safely in any size, any type conduit from 1/2" through 4" I. D.**

**CONTRACTORS SAY — "With Jetmaster, you can wave good-bye to metal tapes."**

*For complete information and prices, write your distributor or*

**JET LINE® PRODUCTS, INC.**

305 Foster Ave. • Charlotte 3, N. C.

# COMPARE\*

**BLACKHAWK'S COMPLETE LINE OF E.M.T. FITTINGS WITH ANY ON THE MARKET**

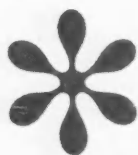


**Quality Controlled at Every Phase of Manufacturing**

1. Compression Type Raintight E.M.T. Connectors, available in sizes: 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"
2. Compression Type Raintight E.M.T. Couplings, available in sizes: 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"
3. Snap-Strap for E.M.T., available in sizes: 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"

4. Blackhawk Offset E.M.T. Connectors, available in sizes: 1/2", 3/4", 1"
5. Set Screw Type E.M.T. Connectors, available in sizes: 1/2", 3/4", 1"
6. Set Screw Type E.M.T. Couplings, available in sizes: 1/2", 3/4", 1"

Judge for yourself how Blackhawk small, easy to use fittings will save time and money on any electrical job.



## COMPARE

SEND THIS COUPON FOR YOUR FREE SAMPLE TODAY

Blackhawk Industries Box 708 Dubuque, Iowa Dept. ECM 12  
Please send my free sample of Blackhawk fittings

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_



**BLACKHAWK INDUSTRIES, Dubuque, Iowa**  
Where the new ideas come from

**Sixth National Electrical Industries Show**—New York Coliseum, New York, N. Y., March 11-14.

**2nd NEMA National Electric Comfort Heating Exposition and Symposium**—Sherman Hotel, Chicago, Ill., March 19-21.

**11th Biennial Electrical Industry Show & Lighting Conference**—Shrine Exposition Hall, Los Angeles, Calif., March 28-31.

**Edison Electric Institute**—Sales conference, Edgewater Beach Hotel, Chicago, Ill., April 2-4.

**Electrical Association of New Orleans Southern Electrical Exposition**—Municipal Auditorium, New Orleans, La., April 2-4.

**Southern West Virginia Home Show**—Civic Center, Charleston, W. Va., April 4-8.

**Rocky Mountain Electrical League**—Spring conference, Harvest House, Boulder, Colo., April 15-17; Fall convention, The Broadmoor, Colorado Springs, Colorado, October 14-18.

**National Association of Electrical Distributors**—Convention, Pittsburgh, Pa., May 12-16.

**Pacific Coast Electrical Assn.**—Annual convention, Ambassador Hotel, Los Angeles, Calif., May 16-18.

**National Fire Protection Association**—66th annual meeting, Sheraton Hotel, Philadelphia, Pa., May 21-25.

**Edison Electric Institute**—Annual convention, Atlantic City, N. J., June 4-6.

**Electrical Apparatus Service Association**—Convention, Conrad-Hilton Hotel, Chicago, Ill., June 10-13.

**Los Angeles Home Show**—Memorial Sports Arena, Los Angeles, Calif., June 21-July 1.

**N. Y. State Assn. of Electrical Contractors & Dealers**—Annual convention, Whiteface Inn, Lake Placid, N. Y., July 2-7.

**Western Electronic Show & Convention**—Memorial Sports Arena, Los Angeles, Calif., August 21-24.

**American Home Lighting Fixture Month**—National promotion, September 1-30.

**Illuminating Engineering Society**—National technical conference, Statler-Hilton Hotel, Dallas, Texas, September 9-14.

**Canadian Electrical Mfrs. Assn.**—Annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., October 3-5.

**International Assn. of Electrical Engineers**—27th annual conference, Sheraton-Chicago, Chicago, Ill., October 3-5.

**National Electrical Contractors Assn.**—Minneapolis Auditorium, Minneapolis, Minn., October 7-13.

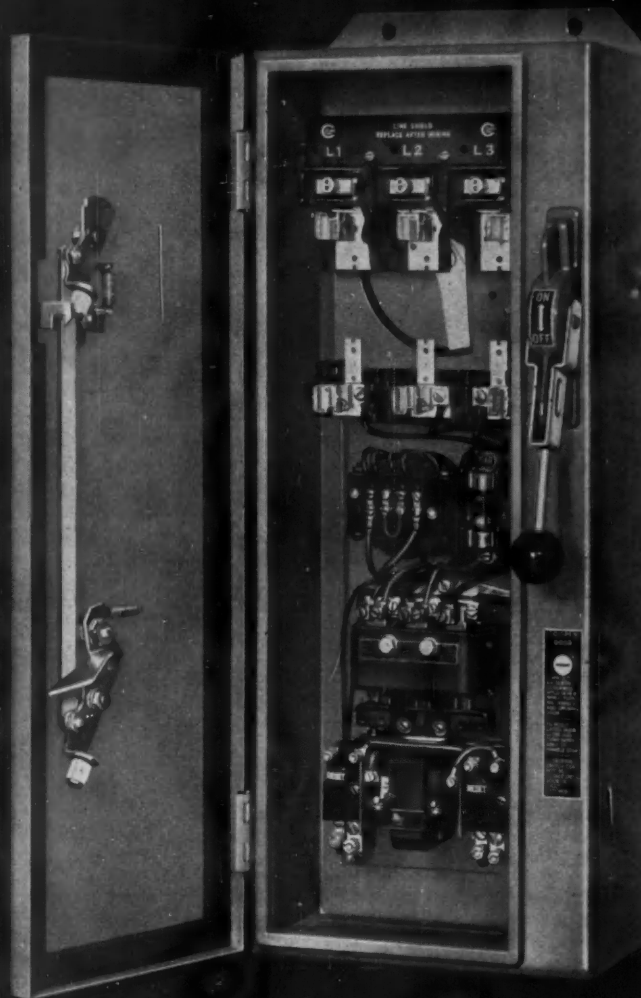
**National Electronics Conference**—McCormick Place, Chicago, Ill., October 8-10.

**National Electrical Manufacturers Assn.**—Annual meeting, Shoreham Hotel, Washington, D. C., week of November 12.



# NEW FROM CLARK

## NEMA 12 SAFETY COMBINATION STARTERS WITH THREE EXCLUSIVE FEATURES



Safety fusible combination starters are gaining wide interest throughout industry. But only the new Clark line offers these important features:

- *New Clark-built visible blade disconnect switch with double-break, silver-alloy to silver-alloy contact surfaces*
- *Disconnect switch accommodates NEC or the new Class J Current Limiting fuses*
- *To simplify installation, complete unit can be removed from enclosure in seconds with no disassembly of handle mechanism*

New Clark Safety Starters offer non-teaseable, snap-action disconnect switch operation. Cabinet design permits only authorized persons to open door when switch is on, or to close switch when the door is open. Dust-tight operation is assured by interlock which requires door handle to be closed and door tightly latched before disconnect switch is operable.

These Clark Safety Fusible Combination Starters are available with interchangeable fuse clips to accommodate a full range of fuses, and are offered with famous Clark "CY" Contactors in sizes 0, 1, and 2. Designed for NEMA 12 (industrial) service, they also are suitable for NEMA 5 (dust-tight) applications. For information, call the nearest Clark distributor or sales office, or write: 618C81

THE  CLARK CONTROLLER COMPANY

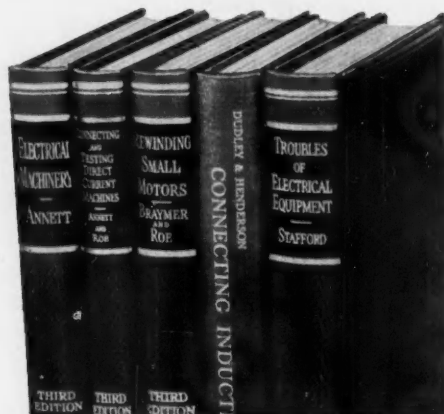
MAIN PLANT: CLEVELAND, 10 • WESTERN PLANT: LOS ANGELES, 58  
IN CANADA: CANADIAN CONTROLLERS, LIMITED, TORONTO, ONT.

# Make 1962 a better year for you

## with one of these 4 GREAT LIBRARIES

Where will you be a year from today? Hundreds of men will be earning more—enjoying more responsible jobs—because they put in a little time every day, building job skill and knowledge with books like these. You can do the same with McGraw-Hill Libraries—selected to give you all-round knowledge of job

fundamentals and develop your abilities in special areas of work. Plan to spend a little of your own time using the "can-ned experience" put into books for you by men who rate high in experience and know-how. It will make 1962 a better year for you, with gratifying rewards in job standing and bigger pay.



### 1 ELECTRICIAN'S PRACTICAL LIBRARY

5 volumes, 2415 pages, 1481 illustrations

This Library prepares you to deal effectively with electric, magnetic, and dielectric circuits. A treatment of electrical mathematics gives you an ability in analysis and calculation that adds both accuracy and speed to your work. Wiring in all its phases is explained and illustrated—home, factory, farm and other requirements are covered. Explanations of electrical machines—generators, transformers, motors, etc.—show you all you need to know to install, test, and operate them. A whole volume covers the problem of controls.

Catalog Price, \$38.50—Library Price, \$29.95  
SAVE \$8.55

### 2 ELECTRICAL MAINTENANCE AND REPAIR LIBRARY

5 volumes, 2079 pages, 1884 illustrations

You can go after the big money in electrical maintenance and repair. This tested, practical 5-volume set shows you how. It takes you, step-by-step through every phase of connecting, altering, testing, and repairing all types of electrical equipment. This library describes how to install motors and generators, and rewind motors—how to inspect and repair starters—locate trouble—test induction motors—and much more. Hundreds of diagrams make everything crystal-clear. Here are proven on-the-job practices of the experts in electrical repair and maintenance.

Catalog Price, \$49.50—Library Price, \$39.50  
SAVE \$10.00

### 3 APPLIANCE SERVICING LIBRARY

2 volumes, 444 pages, 101 illustrations

Covers all kinds of appliances, from washers and refrigerators to hand irons and toasters—shows you facts about their construction and operation needed by the serviceman—and gives step-by-step instructions for finding the causes of breakdowns and correcting them. Besides the direct methods of troubleshooting and repair work, the Library gives you special pointers—from professional testing methods and safety measures to tips on getting business, making service calls, and refurbishing appliances for resale.

Library Price, \$11.50

### 4 ELECTRICAL SYSTEMS LIBRARY

2 volumes, 436 pages, 674 illustrations

Whether you want current for a fan or an elevator—for a private residence or an office building—this Library helps you get the most efficient and economical design. It gives you easy access to today's best design methods, electrical theory, and proved system layouts. It helps you more easily solve electrical design problems in commercial, industrial, institutional, and residential buildings. From lighting and appliance circuits to transformer layouts and motor circuits—all types of system design are explained and illustrated. Over 674 wiring diagrams, schematics, and detail drawings help make this Library your standard guide to modern electrical design.

Library Price, \$17.50

#### SEND THIS COUPON TO SEE ANY LIBRARY 10 DAYS FREE

McGraw-Hill Book Co., Inc.  
327 W. 41st St., N.Y.C. 36, Dept. EC-1

##### 1. ELECTRICIAN'S PRACTICAL LIBRARY

☐ Initial payment after examination \$5.95, followed by monthly payment of \$8.00 until the special library price of \$29.95 is paid.

##### 2. ELECTRICAL MAINTENANCE AND REPAIR LIBRARY

☐ Initial payment after examination \$7.50, followed by monthly payment of \$8.00 until the special library price of \$39.50 is paid.

##### 3. APPLIANCE SERVICING LIBRARY

☐ Initial payment after examination \$5.50, followed in one month by payment of \$6.00 for the special library price of \$11.50.

##### 4. ELECTRICAL SYSTEMS LIBRARY

☐ Initial payment after examination

\$5.50 followed by monthly payment of \$6.00 until the special library price of \$17.50 is paid.

For price and terms outside U. S. write McGraw-Hill Intl. N. Y. C.

Send me the library checked at the left for 10 days' examination on approval. If satisfied, I will send (check one) ☐ full price, or ☐ initial payment followed by monthly payments, according to terms indicated for each library at left. Otherwise I will return books postpaid.

(Print)

Name .....

Address .....

City & Zone ..... State .....

Position .....

Company ..... EC-1



## OUTLOOK FOR 1962

[FROM PAGE 55]

tial, hospitals, highways and sewers will increase 14, 10, 7, and 11%, respectively.

Public residential expenditures in 1962 are expected to return to 1959's peak. In returning to a \$950-million level in 1962 from the depressed 1960 level of \$716 million, this category's rate of gain will exceed any other major public type of construction.

### Public Residential Units

The number of new public units started in 1961 should be about 50,000, and 1962 starts are expected to increase by only 6,000. The Capehart (military) housing program, which during the 1957-59 period accounted for more than 72,000 starts, or almost half of all public starts, is nearing its demise. Only a few thousand Capehart starts are scheduled for 1962. The 40,000 Federally aided State and locally owned new-unit starts projected for 1962 represent a decade's record.

Highway construction, which in recent years has accounted for a substantial part of increased public construction expenditures, again in 1961 and 1962 will provide strong support. About \$400 million of the \$935-million increase for all types of public construction will result from a jump in highway activity to \$6.1 billion in 1962 from \$5.7 billion in 1961. Adequate revenues in the Interstate Highway program trust fund, from which Federal-aid funds are forthcoming, provide a firm basis for the increase. As in 1961, Interstate highway program expenditures will more closely reflect actual road construction, in contrast to previous years when work on bridges and overpasses and other preliminary work were more in evidence.

### Military Facilities

Spending for new Federal industrial and military facilities are not expected to contribute to the overall gain in public construction. The relatively stable long-term requirements, especially in the atomic energy field, both for civilian and military purposes, have resulted in small year-to-year fluctuations in spending since 1956, which has kept



Lots of live wires depend on the protection of Keystone wireways and auxiliary fittings. Quality features such as a completely open 'lay-in' design for fast, careful installation of wires, folded covers for added rigidity and interior screw tip shields—all help to keep electrical wiring *alive and well . . . permanently.*

Keystone has standard or galvanized wireways and fittings stocked in all types, shapes and sizes . . . ready for immediate delivery.

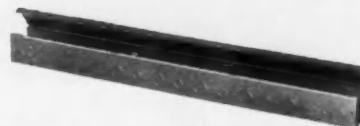
Lots of 'live wire buyers' know they can depend on Keystone . . . what about you?



Telephone Cabinets



JIC Pull Boxes



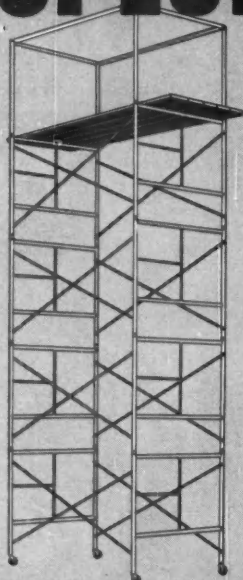
Wireways and Auxiliary Fittings



**KEYSTONE**  
MANUFACTURING COMPANY  
DIVISION OF *Avis* INDUSTRIAL CORPORATION  
23330 Sherwood Ave. • Warren, Michigan

# SPECIAL PRICE

## on steel scaffold



Now—for LESS THAN \$300\*—you can buy enough steel scaffolding for an infinite variety of set-ups—including stationary work platforms up to 24 ft. high, or 77 ft. running length. Use it also for rolling towers with optional casters. Complete package of sturdy, new Safway 4 by 4 frames and accessories stores in 48" x 18" x 50" space; can be easily handled and assembled without tools. Start saving today through increased job efficiency. See your local Safway dealer, or write Safway Steel Products, Inc., 6228 W. State St., Milwaukee 13, Wis. for Bulletin 61F.

### HERE'S WHAT YOU GET

for less than \$300\*

\*(Approx. complete price, less planks. See your dealer for exact delivered price.)

- 12 4 by 4 frames
- 12 Cross braces
- 12 Guard rail posts
- 10 Guard rails
- 16 Base plates

**SAFWAY**

**SAFWAY STEEL PRODUCTS, INC.**  
6228 W. State St., Milwaukee 13, Wis.

SWP-6

## OUTLOOK

[FROM PAGE 153]

the public industrial total at around the \$400-million level. Military construction, which continues to emphasize the missile base program, has fluctuated only moderately during most of the past decade.

### Educational

Expenditures for public educational facilities which are virtually all State- and locally-owned, are expected to increase 5% in 1962, only one-half as much as in 1961—partly because of the somewhat disappointing rate of approvals for new bond proposals in the November elections. This probably occurred because school facilities of many new suburban communities face heavy competing demands for all other types of local community facilities.

Among the other public construction building categories, hospitals and institutional, as well as administrative and service, will benefit from Federal funds. Hill-Burton funds will be important in supporting the approximately \$400-million level characterizing hospital construction activity since 1958. The continuation of an accelerated program for building new Federal office space will assure that 1962 marks a full decade of continuous increases in the administrative and service category. State and local courthouses, firehouses, and offices are also prominently involved in the 1961 and 1962 gains.

Sewer facilities construction, which should increase 11% in 1962, has also benefited significantly from Federal assistance. The recent Congressional increase of grant-in-aid funds for sewage treatment plants was about \$40 million. The projected increase should bring spending to the billion-dollar mark for the first time. Water facilities, which are expected to leap to a new alltime high in 1961, should maintain that level in order to meet growing needs.

Spending on conservation and development projects by the Federal Government during 1961, resulting in a 13% gain, reflected some acceleration early in the year to assist the general economy. A large carryover of work into 1962 for the long-term projects involved provides the main basis for the \$50-million increase projected for 1962.

**4 out of 5  
ELECTRIC HEAT  
WALL THERMOSTATS  
are White-Rodgers\***

Type 1A61  
World's  
Largest  
Seller



Type 1A65  
Elegant New  
Companion

Everywhere . . . people prefer White-Rodgers electric heat wall thermostats—universally famous for styling, easy installation and years of trouble-free performance.

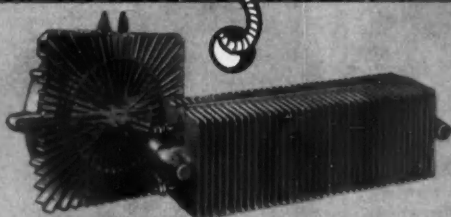
\* Sold under the brand names of more than 50 manufacturers.

**WHITE-RODGERS CO.**  
ST. LOUIS 23, MISSOURI • TORONTO 8, CANADA





# Compare and YOU will Install



Comparison from the standpoint of safety engineering will show there's no unit in electric heating to match Electromode's exclusive All-Aluminum Safety Grid. Only Electromode has this feature, tested and time-proven to be the safest on the market. It's the grid that boosted Electromode to leadership in the electric heating field. There are no exposed hot wires. No glowing coils. All heating elements are permanently embedded deep inside a cast aluminum sheathing, assuring positive protection against fire, shock or burn.



## **Electromode** flameless **ELECTRIC HEAT**

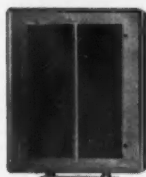
Comparison from the standpoint of performance will show that Electromode's Aluminum Grid has many other advantages, too. Aluminum is rust resisting, non-corrosive. It is one of the best known metals for conducting and radiating heat. Yet its surface temperatures in operation remain amazingly low. Trouble-free Electromode grids are guaranteed five years against burnout and practically eliminate the need for service calls. More and more contractors are installing Electromode because comparison has shown it is the cleanest, safest and most efficient flameless electric heat on the market today. Continue to install Electromode and build up your dividends in mounting customer satisfaction.

### ELECTROMODE LOW-LEVEL BASEBOARD HEATERS



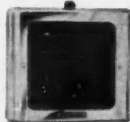
Offer the last word in modern heating for any home. Electromode perimeter heating provides the comfort of radiant warmth along outer walls, under windows and across floors. Come in varying lengths. Customized, matching fittings permit a pleasing baseboard effect in any size or shape room.

### WALL MODEL DOWN-FLO HEATERS



Utilize Electromode's efficient Down-flo principle. Clean, odorless, fan-circulated heat is evenly distributed throughout the area. Ideal for cold hallways, recreation rooms, and other big rooms. Come in both Recessed and Surface Mounted models. All have Electromode's exclusive Aluminum Safety Grid.

### BATHROOM and SMALL ROOM HEATERS



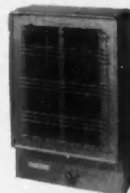
Just right for small rooms. Perfect for bathrooms, where extra warmth is frequently welcomed. Provides quick, economical warmth with the flip of a switch—at the temperature you select. Automatic thermostat keeps it there. Smart styling adds to bathroom beauty.

### PORTABLE SUSPENSION TYPE



Especially useful for supplying extra heat in widely separated areas. May be plugged in temporarily or suspended from swivel-type brackets. Automatic thermostat. Adjustable louvers permit flexibility in directing fan-forced warmed air where most desired.

### COMMERCIAL DOWN-FLO TYPE



Here are units that provide the perfect answer for many hard-to-heat areas. These sturdy heaters come in a wide range of capacities. Abundant, evenly fan-circulated warmth is assured for factories, auditoriums, schools, churches. Automatic thermostat is tamper-proof. Complete heat regulation may be arranged from a remote central control point.

### MEET EVERY HEATING NEED

Electromode's complete line embraces more than 400 types, models and capacities of flameless electric heating units and systems for every purpose. Included are wide choices for residential, commercial, industrial and farm application.

On your next heating problem you'll make a wise decision to contact your nearest Electromode representative or write for free literature to:

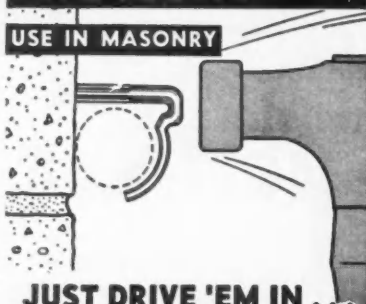
**Electromode** Dept. ECM-12

Division of Commercial Controls Corporation  
ROCHESTER 3, NEW YORK

**NEW**  TRADE MARK REG.

**"DRIVE-STRAPS"**

**THE FASTER WAY TO HANG THINWALL AND RIGID CONDUIT, PIPE, CABLE, BX, etc.**



**USE IN MASONRY**

**JUST DRIVE 'EM IN ... AND DO THEY HOLD!**

VERTICAL THREADS (hardened steel—electroplated). Drives like a concrete nail into concrete block, green concrete, cinder block, mortar and similar materials.



**USE IN WOOD**

**DRIVES LIKE A COMMON NAIL**

ANNULAR THREADS (regular steel—electroplated). Threads "lock" with the wood fibres for up to 3-times greater holding power.

**SIZES FOR EVERY JOB ... AND EVERY MATERIAL**


- DRIVE EASILY
- WON'T BREAK
- NEVER LOOSEN
- COST LESS!

Send For **FREE SAMPLES!**

MAIL TODAY FOR NEW "HI" CATALOG

☐ SEND SAMPLE "DRIVE-STRAPS"

NAME \_\_\_\_\_  
FIRM \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

 **HOLUB INDUSTRIES, Inc.**  
442 ELM ST. • SYCAMORE, ILL.

## Among the Manufacturers

### Headquarters Announcements

Rittenhouse Co., Honeoye Falls, N. Y., has been merged with Emerson Electric Mfg. Co., St. Louis, Mo., and will be operated as Emerson-Rittenhouse.

Holtzer-Cabot Corp., Boston, Mass.—Leonard C. Schmidt, vice president of manufacturing.

Multi-Amp Electronic Corp., Cranford, N. J.—Paul A. Degener, Jr., director; E. R. Redhammer, executive vice president; Louis Tischler, vice president.

J. I. Case Co., Racine, Wis.—William J. Schlapman, Utility-Industrial sales product manager.

Van Huffel Tube Corp., Warren, Ohio—James E. Poss, product sales manager, Power-Strut Div.

Curtis-Electro Lighting Corp., Chicago, Ill.—Irv Wescott, sales promotion and advertising manager.

Sylvania Electric Products Inc., New York, N. Y.—S. George Lawson, vice president and general manager, Semiconductor Div.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—W. E. Korsan, manager of marketing; Paul W. Clark, manager of systems engineering; A. J. Mestier, manager of sales, Industrial Systems Dept., Industrial Equipment Div.; J. S. Morgan, manager of marketing, Power Equipment Div.; Richard L. Engel, general manager, sales and service, Industries Group.

Graybar Electric Co., New York, N. Y.—G. H. Booth, national general lamp and lighting sales manager.

Clayton Mark & Co., Evanston, Ill.—Edgar W. Zemke, regional sales manager of electric products.

Oster Mfg. Co., Wickliffe, Ohio—Richard Humiston, secretary-treasurer.

Warner Electric Brake & Clutch Co., Beloit, Wis.—Edward A. Cleary, Jr., executive vice president.

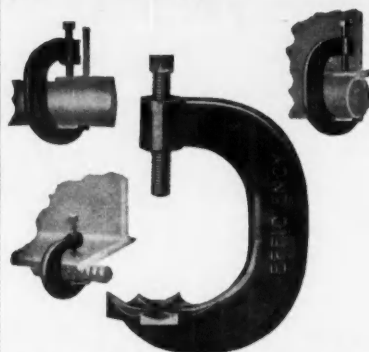
Electric Machinery Mfg. Co., Minneapolis, Minn.—Horace Gelinias, manager of manufacturing; J. E. Murnane, manager of materials.

Volkswagen of America, Englewood Cliffs, N. J.—Paul R. Davis, manager of special projects; Paul R. Lee, manager of newly-formed marketing department.

Westinghouse Electric Corp., Pittsburgh, Pa.—Norman R.

## EFFICIENCY

CONDUIT HANGERS  
for GAS • CABLE  
and AIR LINES



On Steel Construction, "Type F" hangers are best for carrying 1/2 to 2 1/2 pipe and armored cable at any angle to beams.

Write for new catalog

## EFFICIENCY

ELECTRIC & MFG. CO.  
EAST PALESTINE, OHIO

PORTABLE

**Sky Witch**

HYDRAULIC

**WORK  
LOAD  
LIFT**

6 Models  
+ Options

**Lifts Men and Materials to Working Height ... FAST!**

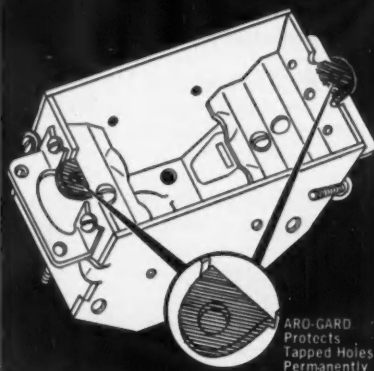
Work height is easily changed up or down by a touch of the hydraulic controls, after releasing the safety lock. The big Sky Witch lifts loads of up to 2000 pounds and extends to heights of up to 30 feet—and there are models to fit other requirements! Ideal for installing and servicing overhead electrical systems! Offered in your choice of power, mounting, and optional features!

**CHARLES Machine Works, Inc.**  
626 Birch St. • Perry, Okla. • FE 6-4404

# ARROLET SWITCH BOXES now have EXCLUSIVE

**ARO-GARD**  
PROTECTIVE COATING

-KEEPS PLASTER OUT  
OF TAPPED HOLES  
IN SWITCH BOX EARS!



\* Pat. Pending

Say goodbye to "plaster fill-in" problems that delay installations and add to your costs. ARO-GARD, Arrolet's new protective plastic compound, is put on over tapped holes during the manufacturing process. ARO-GARD is hard enough to keep plaster out of tapped holes... yet soft enough to allow screws to penetrate protective film with ease.

ARO-GARD is easily identified by its green color (see shaded areas in illus.) Now available in Arrolet's entire line of switch boxes at NO EXTRA COST TO YOU.

Write for samples and data of "ARO-GARD" application process.

SWITCH BOXES • OUTLET BOXES  
BOX COVERS • FITTINGS

**ARROLET**  
CORPORATION

Montgomery, Penna.



Sales Representatives & Wholesale Dealers: ATLANTA, GA. • BALTIMORE, MD. • BIRMINGHAM, ALA. • CHICAGO, ILL. • CINCINNATI, OH. • DALLAS, TEXAS • DETROIT, MI. • GREENSBORO, N.C. • LOS ANGELES, CALIF. • MIAMI, FLORIDA • NEW ORLEANS, LA. • NEW YORK CITY, N.Y. • NEWTON CENTRE, MASS. • PHILADELPHIA, PA. • RICHMOND, VA. • ROCHESTER, N.Y. • SEATTLE, WASH. • ST. LOUIS, MO.

Brown, director of reliability, Motor and Gearing Dept., Buffalo, N. Y.; Howard A. Blair, customer service manager, Air Conditioning Div., Staunton, Va.

McGill Mfg. Co., Inc., Valparaiso, Ind.—James S. Eason, general manager, Electrical Div.

Federal Sign and Signal Corp., Blue Island, Ill.—James F. Jones, president and director.

Electromode Div., Commercial Controls Corp., Rochester, N. Y.—William J. O'Neill, manager of Customer Service and Repair and Rebuilding Depts.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—Paul B. Wishart, chairman of the board and chief executive officer; James H. Binger, president.

Royal Electric Corp., Pawtucket, R. I.—Norman D. Langlois, director of advertising and public relations.

I-T-E Circuit Breaker Co., Philadelphia, Pa.—John I. Ykema, manager, Circuit Breaker Section, Switchgear Div.

Dytronics, Inc., Rochester, Mich.—William L. Neal, product manager.

Joy Mfg. Co., St. Louis, Mo.—Robert W. Minett, Jr., sales manager, Electrical Products Div.

## Regional Appointments

### NEW ENGLAND

Pfaff & Kendall: Charles D. White Co., Boston, representative for outdoor lighting products line in New England with exception of Connecticut.

### MIDDLE ATLANTIC

Graybar Electric Co.: B. F. Benning, eastern district sales manager at Long Island City, N. Y., office.

Black & Decker Mfg. Co.: P. B. Wayman, district manager of Pittsburgh, Industrial-Automotive Div.

Multi-Amp Electronic Corp.: BraBon Electric Co., Inc. Bala-Cynwyd, Pa., sales representative for southern New Jersey, eastern Pennsylvania and Delaware.

Wesix Electric Heater Co.: R. E. Magnell, E. S. Magnell Enterprises, Audubon, N. J., representative for Delaware, District of Columbia and Maryland.

### SOUTH ATLANTIC

General Electric Co.: Charles J. Meloun, general manager of Outdoor Lighting Dept., Hendersonville, N. C.

Black & Decker Mfg. Co.: M. D. Mooers, district manager of Mia-

# "Hi-RED" PLASTIC EXPANDING SCREW ANCHORS



HOLD...  
HOLD...  
**HOLD**  
WHERE  
OTHERS  
FAIL!

ONLY  
**5¢ PER**  
**MOUNTING\***  
(Drill, anchor  
and screw)

\*K-6 KIT

## SAVE UP TO 70%

USE IN ANY MATERIAL YOU CAN  
DRILL: CONCRETE, STONE, CIN-  
DER BLOCK, BRICK, MORTAR,  
TILE, ETC.

## MILLIONS IN USE!

(A REAL JOB-PROVEN ANCHOR)



"Hi-RED" anchors  
may be cut as need-  
ed for short screws



... and used in  
tandem with long  
screws.

- Anchor costs less.
- Costs less to install—takes smaller hole... no tamping.
- Terrific holding power (P.T.L. ratings up to 4,100 lbs.)
- Sizes up to 1/2" lag screw.

BUY 'EM IN BULK  
OR KITS!

**FREE  
SAMPLES**

SEND "Hi-RED" SAMPLES

NAME \_\_\_\_\_  
FIRM \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_



**HOLUB INDUSTRIES, Inc.**

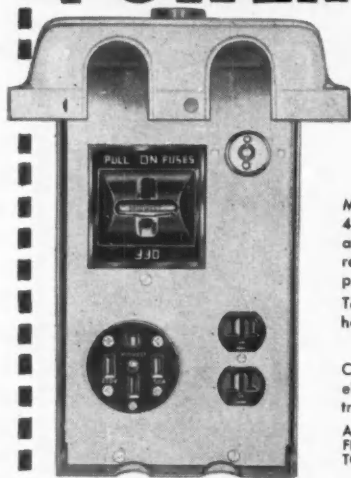
442 ELM ST. • SYCAMORE, ILL.



# Midwest

COMPLETELY WEATHERPROOF  
U-L APPROVED

## POWER OUTLETS



FOR FARMS, RANCHES,  
MOBILE HOME PARKS,  
INDUSTRY, OUTDOOR  
CONSTRUCTION!

MODEL P-55-F, as illustrated, has a 50 amp, 250 volt, 4 wire power receptacle, protected with a 2 pole, 60 amp pull out block. Also has a grounded type duplex receptacle protected with a separate fuse. U-L Approved!

Top hub and three KO's in bottom facilitate overhead or underground connections.

### COMPLETELY TAMPERPROOF!

Cover closes when in use and can be padlocked to eliminate tampering. Also Model similar to one illustrated, with circuit breaker replacing the fuses.

A COMPLETE LINE OF STANDARD MODELS TO CHOOSE FROM IN FUSED OR CIRCUIT BREAKER TYPES WITH 15 TO 60 AMP, 3 and 4 WIRE RECEPTACLES

OVER 100 DIFFERENT MODELS!

SEE YOUR LOCAL ELECTRICAL DISTRIBUTOR OR WRITE . . .

**Midwest ELECTRIC PRODUCTS, INC.**  
1515-M NORTH FRONT ST., MANKATO, MINNESOTA



**TAKING TIME OUT** between sessions of the recent IAEI Eastern Section meeting are NYBFU electrical inspectors C. W. Fenty (L) and W. G. Fleischhauer.

mi; G. H. McLain, sales representative in Baltimore district; Industrial-Automotive Div.

**Remington Corp.:** James H. Bennett, southeastern regional manager headquartered in Atlanta.

**Bishop Mfg. Co.:** Andrew H. Baxter, Washington, D. C., sales representative for Virginia.

### EAST CENTRAL

**Dayco Corp.:** John Shinn, Jr., district manager with headquarters in Louisville; Robert C. Philleo, district manager with headquarters in Knoxville; Industrial Sales Dept., Rubber Products Div.

**Wesix Electric Heater Co.:** John F. Harkey, representative in Indiana with headquarters in Indianapolis.

**Bohn Aluminum & Brass Corp.:** Sam R. Starnaman, sales representative assigned to Chicago district sales office.

**Allis-Chalmers Mfg. Co.:** John C. Collier, regional representative, North Central Region; W. F. Vander Mass, manager of Chicago district; Industries Group.

**Feedrail Corp.:** C. J. Roderick & Co., Memphis, Tenn., representative for Arkansas, western Tennessee and northern Mississippi.

### WEST CENTRAL

**Continental Electric Equipment Co.:** Henderson Sales Co., St. Louis, Mo., sales representative in St. Louis territory.

**Rockbestos Wire & Cable Co.:** Len T. Harper, sales manager of St. Louis district office; James H. McKee, sales manager of new Houston sales office.

**I-T-E Circuit Breaker Co.:** Charles W. Kafka, manager of new Omaha Commercial Apparatus office.

TESTS PROVE:  
**10% more slip**  
with **Y-ER EAS**  
Wire Pulling Lubricant  
For Lead, Rubber, Braid or  
Synthetic Covered Cables

**There is only one Y-ER EAS**

**Don't accept substitutes. The extra slip means extra savings on every job.**

- Creamy, non-corrosive. Never greasy or messy.
- Prevents sticking or setting. Extra slip for saddles and turns.
- Does not run back on cables.
- Never harmful to hands, clothing, cables or conduit.

**NEW! ALUM-N-EAS**  
Thread lubricant stops binding of aluminum conduit connections!

Write for descriptive literature

At all Leading Electrical Supply Houses  
**ELECTRO COMPOUND CO.**  
4149 W. 150th St., Cleveland 35, Ohio

*Full*  
**HOUSEPOWER**  
FUSIBLE  
OR  
NON-INTERCHANGEABLE  
E-Z-RED CIRCUIT BREAKERS

For  
AIR-CONDITIONING  
HEAT  
RANGE  
LIGHTS  
DRYER  
ETC.

**SERVICE EQUIP.  
INDUSTRIAL SWS.  
WIRING BOARDS.  
HYDRALUTION HOME  
LIVE BETTER  
ELECTRICALLY**

**The WADSWORTH Electric**  
MFG. CO. INC.  
COVINGTON, KENTUCKY.  
WRITE FOR FREE CATALOG



## INDOOR and OUTDOOR PHONES that need no current



Your voice  
supplies the power  
needed to operate  
these Sound

Powered Telephone  
handsets over a  
distance of many  
miles. Never fail  
in an emergency.

For temporary  
or permanent installation.



Write for catalog

**HOSE-McCANN**  
TELEPHONE CO., INC.

25th St. & 3rd Ave., Brooklyn 32, N.Y.

### SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT • BUSINESS  
EQUIPMENT — USED OR RESALE  
**OPPORTUNITIES**

#### DISPLAYED RATE

EQUIPMENT & BUSINESS OPPORTUNITY  
Advertising \$24.35 per inch.

EMPLOYMENT OPPORTUNITIES—\$32.60  
per inch, subject to Agency Commission.  
An advertising inch is measured  $\frac{7}{8}$ " verti-  
cally on one column, 3 columns—30  
inches—to a page.

#### UNDISPLAYED RATE

(Not available for equipment advertising)  
\$2.40 a line, minimum 3 lines.

POSITIONS WANTED undisplayed rate is  
one-half of above rate, payable in advance.  
Box Numbers—Count as one line.

Discount of 10% if full payment is made  
in advance for 4 consecutive insertions.

#### Manufacturers Representatives Wanted

Nationally recognized manufacturer of complete  
line of plastic conduit for above and underground  
installations is seeking established manufacturers  
agents calling on the electrical distributor. Choice  
territories now available. Please write in detail to:

Mr. Nathan Pritchett, Vice President,  
Consolidated Pipe Company of America,  
1066 Home Avenue, Akron 10, Ohio

#### WIRE and CABLE WHEN YOU NEED IT

From Chicago you can get immediate  
delivery on all types of Electric Cable.  
Order today. We ship same day.

Send for our latest stock sheet

**UNIVERSAL WIRE & CABLE COMPANY**  
2919 N. Paulina St. Chicago 13, Ill.  
Branches: Los Angeles—Houston—Denver

**Black & Decker Mfg. Co.:** J. R. Steffey, sales representative in Dallas, Industrial-Automotive Div.

**Multi-Amp Electronic Corp.:** Robert D. Cleaves Co., Kansas City, Mo., sales representative for Kansas and Missouri.

**Atlantic Metal Hose Co.:** Landes, Zachary & Peterson Co., El Paso, Texas, representative.

#### WEST

**Allis-Chalmers Mfg. Co.:** T. E. Meyers, manager of Pacific region, Industries Group.

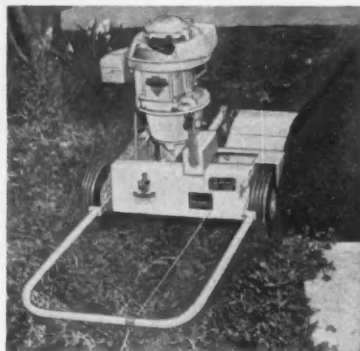
**Edwin F. Guth Co.:** A. G. Miller Associates, Seattle, Wash., sales agent for Oregon, Washington, northern Idaho, Montana and Alaska.

**Wheelock Signals, Inc.:** Don Porter Co., Los Angeles, sales representative in southern California.

**Dayco Corp.:** Donald G. Urpman, district manager in Seattle, Industrial Sales Dept., Rubber Products Div.

**Black & Decker Mfg. Co.:** B. F. Meyers, sales representative in Denver; A. J. McMillan, sales representative in Los Angeles; Industrial-Automotive Div.

**Atlantic Metal Hose Co.:** Landes, Zachary & Peterson Co., Denver, Colo., representative.



#### DAVIS PUP DUG 300,000 FT. REDUCED COSTS BY 40%!

Ray Hansen of Washington Terrace, Utah, dug in excess of 300,000 ft. of trench with the Davis Pup. Costs were cut by 40%.

**ARKLA Gas Company** of Wichita, Kansas, found that six Davis Pups paid for themselves in two months installing gas lights, and subsequently purchased 20 more.

That the Pup is a money maker is proven by thousands of owners. It digs by itself up to 400 feet per hour and handles trenching jobs from 2" to 3" wide, 36" deep to 4" wide, 18" deep. It is fully guaranteed and sells for about \$500. Write—**DAVIS MFG. INC., 1504 S. McLean Blvd., Wichita 13, Kans.**

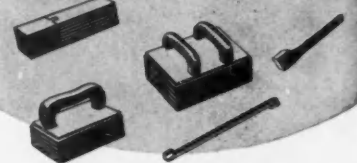
## SAVE down-time man-hours and money



keep D.C. motors  
running longer  
at lower cost ...

**IDEAL**

### RESURFACERS refinish commutators and slip rings without dismantling

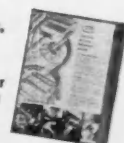


- Performance matched for every condition
- A size and type for all needs
- Accepted standard for quality and uniformity for over 40 years

**NO. 80 IDEAL RESURFACERS** for commutators and copper alloy slip rings are made in six grades. Extra coarse—very fast cutting—for "hogging" off excessive copper. Coarse—for fast cutting. Medium for high mica, small ridges and burns. Finish—for finishing after above uses, and removing small burns and ridges. Polish—fine grade for burnishing. Extra Polish—for production finishing of small commutators.

**NO. 81 IDEAL RESURFACERS** for cast iron and steel slip rings only, in coarse, medium and finish grades as detailed above.

Get the facts on Ideal's complete line of Resurfacers, Flexible Abrasives, Mica Undercutters, Precision Grinders and other accessories. Send coupon for complete Motor Maintenance Catalog.



MAIL COUPON TODAY

**IDEAL INDUSTRIES, Inc.**  
5224-A Park Avenue, Sycamore, Ill. **IDEAL**  
Send me Motor Maintenance Catalog.  
Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_  
SOLD THRU AMERICA'S LEADING DISTRIBUTORS

# More Profit PER JOB More Jobs PER YEAR with **BAKER SCAFFOLDS**



There's no faster way to profits than speeding up the job. It's the ups and downs that cost on off-the-floor work. Baker Scaffolds are designed for minimum set-up and take-down time. Once they're set up, they can roll along the job—straddle obstacles and keep the job moving faster. Baker Scaffolds move through standard size door openings—are designed with a short turning radius. You'll see the reasons why Baker Scaffolds offer greater advantages when you get the facts on higher profit through Baker Scaffolds on your jobs.

Write today for free  
20-page catalog.



Listed Under Re-examination  
Service Underwriters'  
Laboratories, Inc.



## BAKER SCAFFOLDS

DESIGNED FOR PORTABILITY • BUILT FOR DURABILITY

**BAKER-ROOS, INC.**

P. O. Box 892, Dept. # 613 Indianapolis 6, Ind.  
DISTRIBUTORS IN PRINCIPAL CITIES

## ADVERTISERS' INDEX

Accurate Mfg. Co. ....	8	McGill Mfg. Co., Inc. ....	146
Adalet Mfg. Co. ....	107	McGraw-Hill Book Co. ....	43, 44, 45, 152
Adam Electric Co., Frank. ....	11	Midwest Electric Products Inc. ....	158
Advance Transformer Co. ....	134, 135	Miller Co., The ....	101
Allen-Bradley Co. ....	115, 116	•Minerallac Electric Co. ....	118
•Allis Chalmers Mfg. Co. ....	21, 22	Minnesota Mining & Mfg. Co. ....	25, 130
•All-Steel Equipment, Inc., Raco Div. ....	91	National Electrical Industries Show ....	26
American Telephone & Telegraph Co. ....	24	National Wiring Bureau. ....	141
Amprobe Div., Amprobe Instrument Corp. ....	38	Onan Div., Studebaker-Packard Corp. ....	12, 13
•Anaconda Metal Hose Div. ....	93	Oster Mfg. Co., The. ....	112
Anaconda American Brass Co. ....	113	•O.Z. Electrical Mfg. Co., Inc. ....	133
Anderson Electric Corp. ....	2	Paragon Electric Co., Inc. ....	106
Appleton Electric Co. ....	157	Pass & Seymour, Inc. ....	77
•Arrolet Corp. ....	17	Penn Controls, Inc. ....	90
•Automatic Switch Co. ....	160	Pennsylvania Transformer Div., McGraw-Edison Co. ....	27, 28
Baker-Roos, Inc. ....	24	•Phelps Dodge Copper Products Corp. ....	126
Bell Telephone System ....	82	Pittsburgh Standard Conduit Co. ....	10
•Biddle Co., James G. ....	144, 145	•PLM Products Inc. ....	148
Black & Decker Mfg. Co., The ....	150	Plymouth Rubber Co., Inc. ....	125
•Blackhawk Industries ....	136	Pyle-National Co., The. ....	120
•Briegleb Method Tool Co. ....	52	•Quadrangle Mfg. Co. ....	84
Bulldog Electric Products Division, I-T-E Circuit Breaker Co. ....	33	Republic Steel Corp. ....	86, 87
Burndy Corp. ....	131	Revere Electric Mfg. Co. ....	142
Burndy Corp., Husky Div. ....	122, 123	Ridge Tool Co., The. ....	108
Bussmann Mfg. Co. ....	156	Royal Electric Corp. ....	16
Charles Machine Works, Inc. ....	114	•S & C Electric Co. ....	34, 35
•Circle F Mfg. Co. ....	47	Safway Steel Products, Inc. ....	154
Circle Wire & Cable a Subsidiary of Cerro Corp. ....	151	Sherman Mfg. Co., H.B. ....	124
Clark Controller Co., The. ....	Fourth Cover	•Sierra Electric Corp. ....	100
•Crouse-Hinds Co. ....	30, 31	Simplex Wire & Cable ....	85
•Cutler-Hammer, Inc. ....	92, 159	Sola Electric Co., Div. of Basic Products Corp. ....	80
Davis Mfg., Inc. ....	128, 129	Square D Co. .... Third Cover, 1	
Day-Brite Lighting, Inc. ....	147	Stanley Works, The, Power Tools Div. ....	132
Dodge Corp., F.W. ....	4	Steel & Tubes Div. ....	86, 87
Dow Corning Corp. ....	96	Stonco Electric Products Co. ....	149
du Pont de Nemours & Co., E.I. ....	156	Sylvania Electric Products Inc. ....	14, 15, 36, 37
•Efficiency Electric & Mfg. Co. ....	102	U-C Lite Mfg. Co. ....	124
Electrical Tubular Products ....	158	Up-Right Scaffolds ....	20
•Electro Compound Co. ....	155	•Van Huffel Tube Corp., Power-Strut Div. ....	103
Electromode Div., Commercial Controls Corp. ....	109, 119	Volkswagen of America, Inc. ....	49
Erico Products, Inc. ....	83	Wadsworth Electric Mfg. Co., Inc. ....	158
•Federal Pacific Electric Co. ....	46	Wagner Electric Corp. ....	48
•Furnas Electric Co. ....	50	Ward Leonard Electric Co. ....	104
Gedney Electric Co., Inc. ....	18, 19	Wheeler Reflector Co. ....	32
General Electric Co. ....	94	White-Rodgers Co. ....	154
Globe Co., The. ....	23	Whitney Blake Co. ....	95
Goodrich Chemical Co., B.F. ....	6	•Wiremold Co. ....	39, 40, 41, 42
•Graybar Electric Co., Inc. ....	Second Cover	Youngstown Sheet & Tube Co., The ....	78, 79
Guth Co., Edwin F., The ....	138		
Heinemann Electric Co. ....	29	CLASSIFIED ADVERTISING F. J. Eberle, Business Mgr.	
Holophane Co., Inc. ....	156, 157	EMPLOYMENT OPPORTUNITIES ...	159
Holub Industries, Inc. ....	159	EQUIPMENT (Used or Surplus New) For Sale ....	159
•Hose-McCann Telephone Co., Inc. ....	110, 111		
•Hubbell Inc., Harvey ....	131	• These manufacturers advertise their products in the ELECTRICAL PRODUCTS GUIDE	
Husky Products Inc., Div. of Burndy Corp. ....	150		
Jet Line Products Inc. ....	117		
Joy Mfg. Co. ....	153		
•Keystone Mfg. Co. ....	118		
•Klein & Sons, Mathias. ....	88		
Leviton Mfg. Co., Inc. ....	139		
Lighting Products Inc. ....			

**NEW**  
FROM  
**SQUARE D**

**NEW** handle  
design permits  
ganging on 9"  
centers

**NEW** enclosure  
—most compact on  
the market

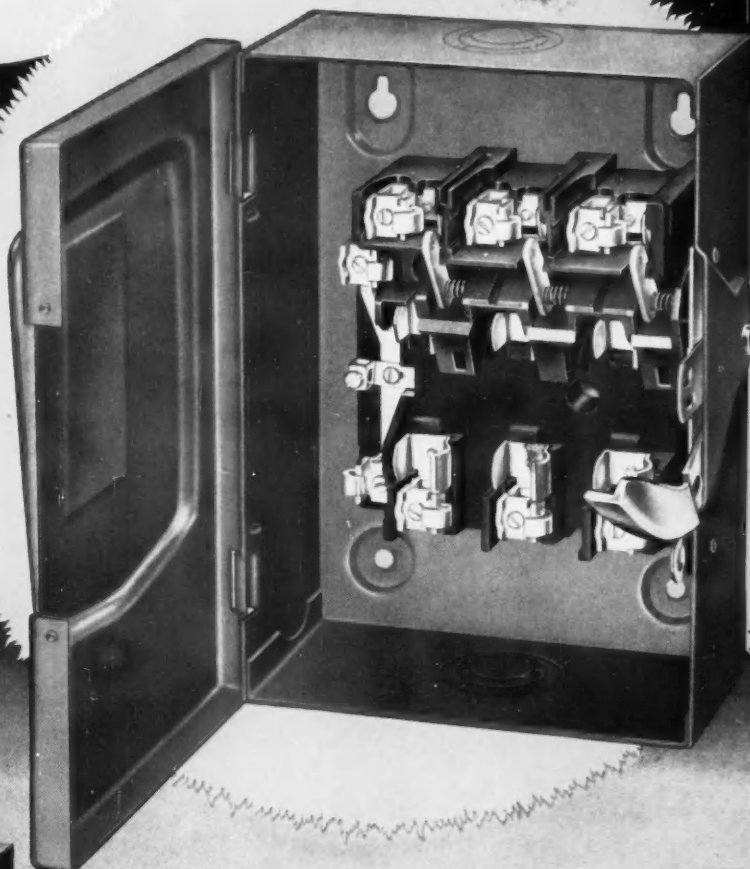
**NEW** larger  
gutters for  
aluminum wire

**NEW** lay-in  
lugs for easier wiring

**VISIBLE BLADES** for  
safety you can SEE

**QUICK-MAKE,  
QUICK-BREAK**  
mechanism

**EXCEEDS** Nema LD  
switch standards



Also  
available  
in  
raintight  
construction



**THIS IS SQUARE D's NEW 60 AMP GENERAL DUTY SAFETY SWITCH**  
—forerunner of a complete line of General Duty switches to  
follow. Here again is design leadership *in action*—leadership  
which has made Square D switches the predominant first  
choice for 57 years. They cost no more... why settle for less?

For descriptive literature address Square D Company, Mercer Road, Lexington, Kentucky



**SQUARE D COMPANY**

wherever electricity is distributed and controlled



Crouse-Hinds offers you the world's widest selection of rigid conduit fittings. Broad choices are provided in both Feraloy® and copper-free aluminum . . . to fit your exact need . . . in 3 competitively priced styles:

#### **OBROUND® FERALOY**

For years, the standard in the industry where cast ferrous fittings are preferred. Made of tough, triple finished Feraloy, with convenient wedge-nut cover.

#### **FORM 8, FERALOY**

Provides Obround's strength and taper-tapped conduit hubs . . . plus extra wiring room for greater con-

venience. Has four cover screws on sizes 1½" and larger, for additional protection.

#### **MARK 9 COPPER-FREE ALUMINUM**

Tough Mark 9 die cast walls are light weight with strength comparable to Feraloy. Self-retaining cover screws. Corrosion resistant . . . the most suitable Condulet conduit fittings if you prefer aluminum or your requirement is aluminum.

● For advice or assistance, see your Distributor or nearest Crouse-Hinds office.



REG. U.S. PAT. OFF.

**MAIN OFFICE:** SYRACUSE, N.Y. **FIELD OFFICES:** Albany, Atlanta, Baton Rouge, Birmingham, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Omaha, Philadelphia, Pittsburgh, Portland, Oregon, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Tampa, Tulsa, Washington. **RESIDENT REPRESENTATIVES:** Baltimore, Md., Meriden, Conn., Reading, Pa., Richmond, Va., Springfield, Mass. **FOREIGN AFFILIATES:** Crouse-Hinds Company of Canada, Ltd., Scarborough, Ont., Crouse-Hinds-Domex, S. A. de C. V. Mexico, D. F. **MANUFACTURING LICENSEE:** Peterco, Sao Paulo, Brazil



